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12 FEBRUARY 1987

China Report

SCIENCE AND TECHNOLOGY



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CHINA REPORT
SCIENCE AND TECHNOLOGY

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NATIONAL DEVELOPMENTS

COUNTRY'S PROSPECTS FOR HIGH-TECHNOLOGY IMPORTS ANALYZED

Hong Kong JINGJI DAOBAO [ECONOMIC REPORTER] in Chinese No 33, 25 Aug 86 p 18

[Article by Chen Minbi [7115 2404 4310]: "What Are the Prospects for China's Importing High Technology? An Interview with Li Huaiyu, Asian and Pacific Manager for Ke Lao Si (Hong Kong) Ltd."]

[Text] Because it had a closed-door policy for so long, China's S&T facilities and research have fallen somewhat behind the Western nations. For this reason, since adopting its policy of openness, China has placed special emphasis on the importation of high technology products and, through holding exhibitions, has come to see that high-technology products are the primary channel of China's present importation of S&T.

The (Ke Lao Si) Company of the United States is a diversified international exhibition and conference firm. Since the restoration of Sino-U.S. trade, this company has sponsored many S&T exhibitions with its sphere of operations extending throughout Asia, Europe, and the Middle East. To develop further its exhibition business in China and the Asian-Pacific region, the (Ke Lao Si) Company has established a local office here in Hong Kong.

According to Li Huaiyu [2621 2037 3877], Asian-Pacific region manager for the (Ke Lao Si) Company (Hong Kong), Ltd., the company will hold many exhibitions in the interior. Among these is the International Electronic Communications-Computer Exhibition, to be held in October in Beijing's China Exhibition Center. In its scale it will be second only to the Geneva International Electronic Communications Exhibition. The company will also hold an international high-technology exhibition in Shanghai at the end of October.

However, can these activities, aimed at introducing high-technology products to China, hold up under a policy which is shrinking the amount of foreign exchange in the interior, coupled with the short-term devaluation of the renminbi?

Li Huaiyu said that in the early years, China really could have imported a large quantity of high-technology products. But the personnel responsible for importing S&T products were not S&T professionals, so they lacked an understanding of high-technology products. They sought to import a large

quantity, but the appropriateness of what was imported was not seriously studied, which led to some machinery being installed piecemeal and the waste of a considerable amount of foreign exchange. She sees this situation as starting to improve in 1982: in that year the central authorities in the interior began to transfer to some degree, with responsible people at the local level gaining the authority to select the high-technology products they needed. Since they were the frontline people using the machines, they had a clear idea of what sort of products they required and therefore could avoid insofar as possible the situation of importing the inappropriate.

In addition, Li Huaiyu noted that it is now possible for concerned departments in the interior, such as the Ministry of Electronic Industry, the Ministry of Posts and Telecommunications, and the Electronic Import and Export Corporation, to send engineers to some large-scale international exhibitions, such as the International Electronic Communications Exhibition. In this way they can learn of advanced foreign S&T, which will assist them in selecting appropriate products.

By 1984, China was on the verge of totally exhausting its foreign exchange and adopted a policy of shrinking the foreign exchange that was available. This in turn decreased the number of products which could be purchased from abroad. Li Huaiyu regards this foreign exchange measure as just a short-term tactic, one which may be relaxed somewhat next year. She noted that in 1981 and 1982 there was a large quantity of foreign goods purchased, which created the foreign exchange shortages of 1983 and 1984. The current policy of cutting back on foreign exchange provides for a period of adjustment, with the central authorities using it to adapt to each department's purchasing pattern and financial planning. She said that this problem will be difficult to avoid in China's development.

Although the foreign exchange cutback is a certainty, Li Huaiyu pointed out that the importation of high technology is still one of the key points in the Seventh 5-year Plan, and the nation's need for high-technology products will be very great. She said that, as noted by the National Council for U.S.-China Trade in the United States, China intends to spend 4 billion this year on improving communications equipment in the interior. The plan also still provides for an increase in the number of telephones to 10 million from the present 5 million, and moreover it adds to this the installation of 3 million telephone lines (including over 1 million lines for computer control and the installation of 6 million lines of electrical cable. The S&T of miniaturization can also successively develop in the interior. For this reason the council also estimates that China's imports of computers will increase 100 percent this year over last year, including as many as 50,000 microcomputers.

Li Huaiyu noted that Yang Taifang [2799 3141 5364], the minister of posts and telecommunications, observed early on that China urgently needs to develop communications equipment, and its development should be carried out faster than in other areas. From this we can see that the influence of the foreign exchange cutback on imports of high technology into the interior is really not all that noticeable. Actually, China will receive a loan of \$100 million next

February from the World Bank, which will be used for development in four areas, i.e., microcomputers and semiconductors, laser technology, optical fibers, and automated machinery.

As for the short-term devaluation of the renminbi and its influence on the importation of S&T, Li Huaipu feels that this will only have a psychological effect. But its real effect will not be great, because foreign firms generally turn back to U.S. dollars to calculate. As for those foreign businesses which have already set up companies in the interior, their building rents may as a consequence come down still further. She said that her intuition is that devaluation of the renminbi might result in a decrease in imported goods in the interior. However, problem remains that the importation of high-technology products is an important item in the Seventh 5-year Plan, and the interior's need for high-technology products is definite. In addition, the holding of a major exhibition in China, with the support of the China Council for the Promotion of International Trade (CCPIT), is evidence of confidence in commercial development.

While China has stressed the development of high technology, it remains that there is a continual improvement in S&T today. It is possible that shortly after the interior has imported a certain series of S&T products, the progress of still newer technology could place China in an unfavorable position in overseas market competition by using the older-product technology to manufacture its exports? And could this even extend to the point of China's forever being a high technology-importing nation?

Li Huaipu observed that the high technology which China is importing right now is mainly centered on industrial production, which cannot be developed too quickly. In market place competition, because the production process is semi-automated, with part of the process requiring manual completion, added to the cheap labor force in the interior, the result is that resold products have a certain amount of competitive force. As an example, we have computer backplanes, of which China is already an exporter.

As for the most sophisticated high-technology products, the advanced Western nations generally have laws and regulations which deter their transfer abroad. Li Huaipu said that while Western nations export high technology products to develop China, there are some things which are held back; this is especially the case with electronic products which can be used in national defense. However, this year the holding-back procedure has been progressively relaxed somewhat.

Table 1. Monetary Worth of Major Electronic Product Imported by the Interior
(in millions of U.S. Dollars)

Name of Product	1984	1983	1982
Classes of communications equipment	530,31	250,85	134,14

Electronic computers	305,74	139,97	111,82
Large and medium-size electronic computers	63,48	41,82	24,15
Electronic components	115,72	44,35	17,82
Classes of electronic	391,73	195,09	160,41

Source of data: "China Foreign Economic Trade Yearbook 1985"

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NATIONAL DEVELOPMENTS

EXPERT URGES STRESS ON TECHNOLOGY OVER THEORY

Beijing GUANGMING RIBAO in Chinese 29 Aug 86 p 2

[Article by Luo Peilin [5012 7198 7207], member of the Scientific Council of the Chinese Academy of Sciences and vice chairman of the Ministry of Electronics Industry's S&T Commission: "China's Present Situation of Weak Engineering and Technology Should Be Changed; the Current Phenomenon of Stressing Theory and Belittling Skills Is Detrimental to Scientific Development"]

[Text] At present, many professionals hold the common opinion that China's current S&T stress on engineering and technology is not enough. During the past several years, China's economy has developed considerably, but if we are to maintain the economy and sustain the speed of its development, the problems of insufficient funds and a lagging technology urgently require solution. Speaking of engineering and technology, if our present weak condition is not altered, then there will be severe limitations placed on the development of new products, improvements in technological quality, the digestion, assimilation, and bringing forth of new ideas from imported technology, R&D in new high technology, etc. These in turn will have an increasingly negative effect on economic benefits. This strategic problem is gaining national attention.

In the broad sense, science includes pure science (or that part which approaches purity) and technology (or that part which can be applied). More specifically, it can be classed in five parts: basic science, applied and technological sciences, technological inventions which can be created from the ideas of basic science, and maintenance technology which is applied to technology for daily operations. Finally, there are two parts which belong to engineering technology in production: these are the S&T that directly engender economic and societal benefits, and these compose our S&T front line. In these five parts, our strength should be concentrated especially on the frontline work.

From the standpoint of quantity in research work, the manpower and materiel required to develop frontline engineering and technology research are frequently 100 to 1,000 times more than what is required to do basic research. As for research personnel quality requirements, a good engineer or engineering project organizer is probably a person of talents and attainments, by no means

inferior to a scientist. It should be noted that the quality requirements for a scientist are about equal in importance to those for an engineer or technologist. Moreover, when it comes to what is required in numbers of support personnel, the needs of the latter are much greater. Our present situation is that, no matter whether the engineering site is still at the lowest level of industry, they are all very weak technologically, which corresponds to the complete lack of that quality we need in our engineering and technological personnel. Because of this, the quality of our engineering, the quality of products, the forces of production, everything at the operational level is lagging, and the efficiency rate is very low. In point of fact, China's engineering and technological team has great potential. The reason is why that potential has not been tapped lies principally in the fact that policy and management have paid insufficient attention to the team. The treatment of engineering and technological personnel is still unequal to that of scientist in such areas as wages, position, reknown, and academic degrees. The phenomenon of emphasizing light industry has created an irregular movement of personnel with serious implications for economic and societal development.

If we stress frontline technological work, we can draw inspiration from the course of economic development in the United States and Japan. In its developmental years, the United States transplanted Western European technology and made technological development the starting point in economic development. The Bell Telephone Laboratories were established in 1925, marking the beginning of applied research in the United States. Later on, due to the needs of developing manufacturing technology, plus the stimulus provided by World War II, applied research developed rapidly and put the United States into a position among the world's elite. Widespread development of basic scientific research did not start for the most part until 1950, with the establishment of the National Science Foundation. As a result of the United States' very solid technological foundation, basic research was able to enter the world's front ranks rapidly.

During its postwar recovery, Japan developed its economy initially through the use of cheap labor and imported foreign technology. At this time, Japan put the importation and assimilation of foreign technology in a position of priority. The result was that although there were very few Japanese inventions or innovations, the nation still evolved into an economic power. Now the Japanese are proposing that their basic research be strengthened and have even said that this stage is acknowledged to be a late one. Actually, we have seen that if it is done early, one fears whether it will be done at all.

After the founding of the Soviet Union, the developmental focus was on basic science for national defense. Soon afterwards, the emphasis was placed on such long-range projects as space technology, nuclear fusion, and magnetic fluids. Because of this weak basic technological development, the Soviets fell behind in the industrial technology interrelated to their national economic growth, even though they move right along in such areas as basic science and space technology.

In summary, I believe that China should consider carefully this fundamental question in its development. Naturally, we cannot ignore basic research in

fields such as biology, physiology, geology, and chemistry which in the near future will have practical significance. Nor can we ignore the considerable applied research being done in mathematics, physics, and astronomy, information from which will also have practical significance. But we must overcome the scholarly community's traditional emphasis on the theoretical while slighting the skilled, that is, a situation which stresses theory while belittling the practical. Change this, and modern economic and societal development will not be like adapted ideology.

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NATIONAL DEVELOPMENTS

SICHUAN TO BUILD TECHNOLOGY DEVELOPMENT MANAGEMENT CENTER

Chengdu SICHUAN RIBAO in Chinese 14 Jul 86 p 1

[Article by Ran Lian [0373 6647]: "To Augment the Opening of Technology Markets; Sichuan Will Establish a Technology Development Management Center"]

[Text] The provincial people's government has approved the establishment of a technology development management center in Sichuan, the purpose of which will be to organize the flow of S&T information and open up the right kind of technology markets.

According to responsible comrades involved in the work of opening technology markets in Sichuan, such a center is clearly essential if Sichuan is to maintain its pace in construction and development. Sichuan is a landlocked province, vast in area and rich in resources which urgently await rational development and use. Development is uneven throughout the province, with many rural areas especially being "old, lacking, and close to poor." These places yearn for the prosperity that technology can bring. There are more than 100,000 large, medium-size, and small enterprises in Sichuan, which are confronted with the problem of bringing themselves to a superior position, while at the same time are faced with the numerous aspects of reforming their own technological mission. Sichuan has more than 400 research and planning units, 57 institutions of higher education, and many large and medium-size state-run enterprises. These possess excellent equipment and are a solid S&T team. But due to their being mutually disjointed, their strength is dispersed, they lack crosswise cooperation and so have been unable to exploit their abundant intellectual resources and outstanding equipment. Such has especially been the case for the many research accomplishments accumulated in Sichuan over the years: a considerable number of these have gone no further than being samples, exhibits, gifts, or unused stored products, never becoming a production force. The work of opening technology markets is urgently in need of strengthening.

The provincial government, observing that Sichuan still lacks a province wide technology development management organization, has concurred with a report of the provincial scientific commission and has established the Sichuan Technology Development Management Center. This center will be part of an enterprise-quality enterprise management unit. Its primary missions will be: to develop and promote more effective and speedier technological results; to

conduct the technological markets the province has lacked for so long; to concentrate on technical training for technology transfer; to circulate economic and technological information; to promote the rational transfer of personnel; and to develop cross relationships. It will organize and participate in various kinds of forms of research, education, and production jointly with either one or a group of enterprises. Finally, it will coordinate and manage Sichuan's technology markets.

A concerned responsible comrade observed recently that the technology markets are in their fundamental stage, and the government must continue to practice a policy of "opening up, carrying on, fostering, and leading" the technology markets. Every unit and organization involved must work together as one, supporting the building and development of technology markets.

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NATIONAL DEVELOPMENTS

INDUSTRIAL-ACADEMIC COOPERATION REPORTED

Beijing RENMIN RIBAO in Chinese 4 Sep 86 p 1

[Article by Zhang Chijian [1728 2170 1017]: "Plants Raise Funds for Building University Laboratories; University Opens Advanced Products to Plants; State Economic and Educational Commissions Approve Unity of 14 Plants With Qinghua University"]

[Text] At the first Harbin conference, comrades from the State Economic Commission and the State Educational Commission approvingly told reporters that 14 plants which report to the Ministry of Electronics Industry, with great foresight, have raised funds for Qinghua University to construct a "laboratory dedicated to electrical circuits." This will assure that new products are opened up to the plants and their S&T personnel will be developed.

These plants are all engaged in the manufacture of communications and broadcasting equipment. They have observed from the trends of the world's advanced technology development and the extreme importance of "integrated circuit" design technology. However, the plants have had difficulties mastering this new technology, while Qinghua University has been engaged in this kind of research since 1980, and very effectively. However, a shortage of funds, combined with a lack of the necessary laboratory conditions, has definitely influenced this research.

Linked up, both sides "fit in readily." Even though these plants were also lacking in funds, still they collectively raised 1.7 million yuan for Qinghua University to purchase equipment. The laboratory is presently just in the midst of construction. After construction is finished, Qinghua plans to provide S&T personnel training for the plants, while at the same time they furnish newly designed "integrated circuits" for the plants, serving them by opening up advanced-level products.

This novel arrangement was widely discussed at the "Conference on Strengthening Enterprises' Technology Development and Promoting Crosswise Cooperation," which was convened the other day in Harbin. Critiques by comrades from the State Economic and State Education Commissions praised three points: first, the plants showed vision in parting with their own funds in order to open up new technology; second, the joint action of businesses and

plants applying limited funds to key areas is also helping to avoid duplication of effort; and, third, this is bringing academic research fully to a dominant position. Their joint conclusion: This matter indicates that the unity of plants and research units is entering a still higher stage, one deserving of emulation!

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NATIONAL DEVELOPMENTS

DEMOCRATIC, SCIENTIFIC POLICY MAKING DISCUSSED

Beijing RENMIN RIBAO in Chinese 5 Sep 86 p 5

[Article by Lin Zhiqun [2651 1807 5028]: "Strong Push for Making Policy Democratically and Scientifically; Important Significance and Use of Discussing Soft-Science Research from the Standpoint of Technology Planning"]

[Text] For those people with a sense of historic mission and a dedication to reform, there are some things in the more than 30 years since the founding of the PRC which makes us heave a great sigh and rue the past. Probably nothing more so than the repeated mistakes in important national policies, in particular the abnormal phenomenon of a type of policy which undemocratically and unscientifically permits no veiled criticisms of any kind. It can be said that from the start of the 1980's, under the joint organization of national planning and economic and scientific commissions, and with the State Science and Technology Commission assuming responsibility for the 12 important national leading technological policies, the level of policy formulation has been raised. The important and sensitive questions of the policy formulation process are significant in practice and confusing in any case. The significance and use of these far exceed any concrete results of a blue book and have far-reaching influence.

Eliminate the Old Viewpoint That Policy Is Mysterious and That Discussion of Politics Is Dangerous

For a very long time after liberation, the formulation of major policies in China was characterized by excessive concentration. Many cadres knew very little about the policy decision process. Experts and scholars in every field were even more limited in the influence they could exert. Therefore, there was a sense of mystery about policy for many people and numerous cadres: this was said to be right today, but that will be right tomorrow--back and forth until both are correct. If anyone wanted to express an opinion concerning a policy, they would be out of luck in a great many circumstances. The most prominent examples of this were when General Peng sought to eliminate the negative aspects of the "Three Red Banners" and vigorously set forth his attacks and persecution for his efforts to stem the population explosion and promote family planning. Blocking people from communicating their criticisms and suggestions will in the end bring people to a state of just knowing without speaking, of being world wise while playing it safe. In our

construction community there was once a scholar as well known as Mr Liang Sicheng, but who in his entire lifetime never wrote an article and never spoke out expressing his beliefs.

I have had the good fortune to take part in the work of formulating the technology policy mentioned earlier. The greatest impression I gained from this was that formulating policy in this way brought a fresh breeze. Leaders and ordinary people were treated equally. There was no hands off the plan here: we invited discussion and criticism, opening up the summarized goals for each side's specialists to express their views freely. There was a total reliance on mass discussions, analyses, and conclusions which eventually shaped the essentials of policy. The entire process embodied the scientific method as well as the democratic way and thereby positively mobilized the enthusiasm of the participants. Many people are very conscientious about the writing of expository materials, and their contribution of many years of research results and systematic background data ensures the high quality of the policy documents.

The work of writing policy in major areas of technology policy is very influential and in both breadth and depth impels the opening up of the channels of thought and speech. On the one hand national technology policy gives impetus to the technology policies of every department and every industry. For example, a city or village establishes an environmental protection department and then mobilizes several hundred experts to lend a hand in drawing up a "construction technology policy." On the other hand, various kinds of technology policy documents are drawn up according to the basic plans and programs of various departments and localities. An example of this is Shanghai, which according to its "Policy for Residential Construction Technology" researched and drew up a "Shanghai 8-year Plan for Resolving the Housing Problems with Homeless Families." At the same time, in keeping with the policy formulation, there may spring up many strategies for development that are broad in content, along with forecasts of the future and much important research on policy problems. Society has short-term technological needs, which can exceed what was the routine pace of the past in breadth and depth, hurtling science forward. China's soft sciences have had unprecedented vigor and prosperity in recent years, and the reasons are here.

People often smoothly and easily forget that setbacks can be precursors of maturity and success. This is so because we go along an endless, winding, and hard road so that both technology policy formulation and much soft-science research start out from a summing up of the lessons of past experience. As an example, over these past several years there has been a thorough, practical, and realistic analysis of the historical experience of China's rate of progress toward urbanization. This will allow us to know accurately this important historical phenomenon and proceed to the next step in selecting the correct measures to enhance possibilities.

Urbanization is the development of an agricultural society into an industrial society and the development of a natural economy into a commodity economy. This is an inevitable rate of progress and a common tendency; no nation in the world can be an exception to this. This has been proven in the more than 200

years since the Industrial Revolution, and it should be just that way for China too. In 1949 China's urbanization level was only 10.6 percent, demonstrating that China's true condition was still that of a basically agricultural society. During the 3 years of renewal and the First 5-year Plan, the nation established large-scale development, furthering the urbanization level somewhat, and the situation was relatively normal. But by the end of the 1950's, a large number of agricultural workers were recruited to enter the cities, and these for the most part exceeded in consumption the production capability of commodity foodstuffs. Consequently, when there were 3 years of difficulties, there was a mobilization of more than 20 million to return to the countryside. Even more unfortunate from this was the "urban fear syndrome." By the arrival of our 10 years of chaos, there was simply a massive dispersal into the countryside, with no effort spared to carry out the policy of ruralizing the cities. The promotion of "we also have two hands and will not loaf in the cities" as a guiding ideology stood on its head the objective reality, which was to advance the cities while letting the rural areas lag behind. In the nearly 2 decades from 1960 to 1977, China's rate of urbanization fell behind and came to a standstill compared to the former situation. This went against the trend of the rest of the world. For the past several years, through objective, calm, and thorough discussion this historical trend is more clearly understood. Only now, in the midst of the reform of the rural economy, are large numbers of people in this surplus labor force being released from working the land. This is a more correct theoretical understanding and ideological preparation. Many experts now agree that by the year 2000 more than 200 million rural people will leave the land and become a non-agricultural populace. This will necessarily accelerate the pace of urbanization and confront the urban population with increasingly greater pressures. A well-arranged solution would be to strive to the utmost to develop enterprises in villages and small towns, establishing a large number of small-scale towns and enticing a sizable group of the non-agricultural population to come back. This could be a distinguishing feature of China's road to modernization.

People know that complex matters, or restrictions placed on various things, or dissimilar views often give rise to a problem having many kinds of widely varying answers. The irregularity of this kind of knowledge leads to a lack of uniformity in public opinion; this is a totally normal state of affairs. In this round of discussing and formulating technology policy, leaders have kept their heads clear and paid special attention to uncovering contradictions, aware of the need to organize differing views into debate. Many important problems were thereby solved through this spirit. If a complex problem were encountered, or if there were an unclear situation or immature conditions, there would be no insistence upon uniformity, so as to avoid bias. This way is practical and realistic, the correct ideological line in handling technological problems, and should be promoted enthusiastically. For example, from the start of this decade, China's construction community has had two sharply differing viewpoints concerning highrise dwellings. One holds that highrises are harmful and lack advantages, because building costs are twice those for multi-level dwellings, daily transport and buildings safeguards are costly, and the space utilization coefficient is low. Although there is some economizing on land, still it is not worth it and goes against the

international trend. The second view sees highrises as something difficult to avoid and holds that if large cities do not push them resolutely, there will be no way for older regions in transition and central areas being developed to resolve the problems of homeless families and make full use of scarce space. At the same time, there is no lack of successful experience with high-rise dwellings available from foreign countries. Hong Kong is a case in point. In 1983, while we were researching and drawing up our "Policy for Residential Construction Technology," we were aware of and even advocated this argument, but were unable to reach a consensus. By 1986, when the local construction bureau had drawn up and issued its "Policy on Construction Technology," this argument was just the same as before. The reason for this lies in two related factors, neither of which has yet had a clear-cut solution. One is the problem of land costs, which vary greatly in different cities and sectors. Before liberation, the cost per mu of land in Shanghai was upwards of 1,000 times more expensive than in the remote suburbs. But now, this land cost disparity problem cannot be stated clearly in either theoretical or practical terms. This being the case, there is no way to differentiate and choose between the highrises' economizing on land costs and the multi-level dwellings' cutting construction costs, as they are not in the same category of costs. The other problem is that of equitable rents. The rents currently in effect are due to large national subsidies and are separate from construction costs. The rents for highrise residences are basically approximate to those of multi-level dwellings, and the rent paid by households is much lower than the construction costs, so that neither highrise nor multi-level dwellings quickly attain any economic benefits from rental receipts. The result is that the existing contradictions between the two types of dwellings are concealed. It appears that this argument will be ongoing, and a bit more leadership is needed.

In the Mutual Discussions Between Different Disciplines and Departments There Will Begin To Be Established a View of the Overall Situation for the Balanced Development of the Economy, Society, and S&T

After the 3d Plenary Session of the 11th Central Committee, there was abundant proof that "leftist" thinking in economic construction caused flawed policy making. The chief manifestation of this was the subjectivity and one-sidedness which created a proportional imbalance, so that eagerness for quick success and instant benefits resulted in haste making waste. Everyone remembers all too well the grave consequences caused by the brave words and "leftist" slogans of those years, such as "if the people are courageous, the land will produce much," "taking steel as the guiding principle, take the lead and go full steam ahead," "iron and steel production will double in a year," and "first control the slope, then control the valley." However, that kind of onesided view which stresses the economy while slighting society and S&T, which emphasizes production and ignores the circulation of consumer goods, is still as prevalent in the marketplace as before. Directly opposed to this malady is the first batch of 12 important areas of technology policy, which include municipal construction, village and small-town construction, rural residential construction, and environmental protection, emphasizing such "unproductive" areas as societal benefits. It must be said that this choice shows considerable strategic vision. There have been many lessons to be

learned from old truths in several areas since the founding of the PRC. Speaking of municipal construction problems, for how many years now has the macroscopic distribution ignored science while overemphasizing wartime factors? Going to places far from the economic centers and away from the main transportation routes to do the three large and small lines of "mountain, scatter, cave" and "sheep empties its bowels" ran counter to the scale of the economy. This caused the loss of a large amount of industrial production which requires appropriate concentration before it can take a dominant position in its production of relevant benefits. It should also be based in the relatively better-off eastern coastal area. At macroscopic administrative levels, this reflected the relative concentration and high efficiency of the cities; what they absolutely must have to function was devalued as "unproductive construction" and was underestimated. As a result, there was a complete tightening up of such things as roads, communications and transportation, water supplies, sewage, etc. in big and small cities alike. This not only inconvenienced people in their daily lives but still more importantly caused a deterioration in the cities; already lagging socioeconomic rate of efficiency and functioning. In the current round of technology policy formulation, many confused understandings are being clarified. Some problems have received special attention and some have not been solved better to varying degrees. This is the situation in residential construction. The formulation of the "Policy on Residential Construction Technology" also persists in its advocacy of housing programs which are compatible with policies interrelated with technology policy, providing still more impetus to the work of residential construction.

In recent years the situation in soft-science research has been very good, but we can see that this is only a beginning. The problem before us is how to consolidate and develop this favorable situation. As I see it, there are two areas which we must pay attention to by doing well: one is that ideological thinking needs to be deeper, which will create the spiritual conditions for moving the work forward; the second is to select effective measures in a down-to-earth manner, creating the material conditions for moving to work forward. The central problem here is to have genuine trust in China's intellectuals, and absolutely not proclaim some stratagem, then bind them into a cocoon.

Soft-science research encounters some macroscopic policies and major theoretical questions. In this regard, do there still exist artificial, non-essential, or forbidden zones? I know that these exist to varying degrees. We should advocate that "science has no forbidden zones." We should believe that the vast majority of China's S&T workers and theoretical workers are patriotic and conscientious. It has been factually demonstrated that while they are not the principal carriers of unhealthy tendencies, they are also not the leading edge in enthusiastically following fallacious ideas. At present, our economic system is just in the midst of carrying out vast and deep reforms; it also seems as if proposals for reforms in our political system are the order of the day. These reforms, regardless of their content, nature, depth, or breadth, are all unprecedented. At a great historical juncture of this sort, what is needed is not just accurate policy formulation from the party Central Committee and the State Council, and the millions upon

millions of masses to carry the policy out; we also need some professionals, scholars, business people and old hands to act as braintrusters in tactics and in theory and to do the probing, deliberating, seeding, and cultivating. Almost any viewpoint which has been formed from deep thought, regardless if it is weak in some way or another, or even if it is erroneous, is still capable of providing a variety of options from which those formulating policies can choose. How is this bad? For several years the vital S&T policy formulation work which can obtain better results has hinged upon the two characters for the word "trust." Trust can produce our braintrusters, and it can produce talent; trust can obtain popular support, and it can obtain sound strategies. The enthusiastic participating of S&T workers and theoreticians will furnish a solid scientific and democratic foundation for national policy formulation and decisionmaking. Policy will then be more reflective of objective law and of the will of the people. Making policy formulation democratic and scientific is absolutely not a question of methodology, but is rather the concrete incarnation of the correct ideological and political lines.

Today we can focus on the nation's approximate policy center and comment on the past while looking forward to the future. It is in itself sufficient to say that our stability and unity are due to the societal environment having a easygoing and self-confident strength. Modern times of prosperity should have a democratic, egalitarian, magnanimous, and agreeable environment. This kind of environment is beneficial to breeding a more mature and more vigorous theory, ideology, and policy. We will not oppose calling it another kind of good cycle--a good cycle in a productive spirit. If all of us cherish and progressively create and uphold this kind of good cycle, then China's soft sciences will prosper and make new contributions to rendering our policy making more democratic and scientific.

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NATIONAL DEVELOPMENTS

SICHUAN SPARK PLAN RESULTS REPORTED

Beijing GUANGMING RIBAO in Chinese 29 Aug 86 p 1

[Article by Yang Li [2799 0500]: "Being Practical and Realistic, and Concentrating Its Strength on Key Points; Sichuan Reviews and Revises the First Batch of Spark Plan Projects; All levels Are Clearer on Their Understanding of the Spark Plan; Because of Economic Guarantees, Over 90 Percent of Key Projects and Topics After Revision Will See Benefits or the First Step Toward Benefits Within 1 Year"]

[Text] Recently, Sichuan reviewed and approved a batch of projects under the "spark plan," deciding to start out from realistic benefits and concentrating on implementing projects which will see benefits quickly.

Originally, there were 46 projects in Sichuan's first batch to be implemented under the "spark plan." After review and approval by Sichuan, these projects were revised in a way that is practical and realistic.

Projects or topics which are technologically sound and well managed and advance at a rate which will enable them to see benefits within 1 year are given every possible guarantee, encouraging them to attain benefits quickly. For example, Xuanhan County undertook a special project on "multiple type fire resistant materials product development." This locality has abundant raw materials as well as superior conditions for production and advanced technological facilities. In addition, the product is in great demand in the domestic market. From its inception last year, the project both extended its factory building and developed its engineering rapidly as well as improved product quantity and quality. However, the original engineering plan allowed for too little funding, so an additional 500,000 yuan were urgently required for its completion. After review, Sichuan's Science and Technology Commission, along with other financial and funding departments, decided to assist in solving these funding problems so that the project could be completed by the end of October and formally go into production. According to the plan, after formal production begins, annual output will range from more than 6,000 tons to 13,000 tons. In 1986 there will then be an increase in value worth 400,000 yuan, with 80,000 yuan in taxes and 135,000 yuan in societal benefits.

For those projects which are of high value but are still lacking the technological conditions, so that they will have a difficult time seeing results within a year or two, implementation will be delayed temporarily. For example, Sichuan University and Chengdu undertook a "solidified cell culture technology for the manufacture of soy sauce." This was a continuation of China's research project on "solidified cell culture technology for the manufacture of alcohol," and so received the special attention of central leading comrades and the State Science and Technology Commission. If this project succeeds, it will fundamentally alter the areas in which China has fallen behind in its manufacture of soy sauce through the long-term use of old methods. However, specialists in the review recognize that the use of this new technology to manufacture alcohol and soy sauce still faces some difficult problems which must be resolved. Within a short time it would be hard to see benefits, so that decision was made to postpone the project. Each year it will receive a certain amount of research funds, and arrangements were made for it to be a "spark plan technology early-stage development and testing" project.

For those projects which are lagging technologically, poor in benefits, impracticable, or too grandiose, a decision will be made to terminate. For example, Nanjiang County assumed responsibility for "glazed color exterior wall brick." Before reporting, a thorough review was made as to whether there was a supply of materials, market conditions, etc. During implementation, again based on lagging technology and poor management, the project attained exceedingly poor benefits and went heavily in debt. In July, the Sichuan Science and Technology Commission decided that this special project would not again be included in the first-batch implementation plan and further recommended that this enterprise made a change in product.

By means of this revision, Sichuan delayed or terminated a total of five of the initial group of major "spark plan" projects, which was 11 percent of the total number of such projects. Eight minor special projects were delayed or terminated, which was approximately 10 percent of the total number of such projects.

Making the revisions in a practical and realistic manner brings with it two obvious results: the first is that all levels now have a clearer understanding of the "spark plan" than before, meeting prior demands for more clarification. Projects reported recently generally fit in better with practicalities and lay more stress on economic benefits. The second result is that key projects and special topics, handed down after revision, now have guarantees of funding. Originally the total funding required was 27,320,000 yuan; now, only 24,477,000 is needed. This way, more than 90 percent of the projects and special topics can see results or progress toward results within a year.

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NATIONAL DEVELOPMENTS

BENEFITS FROM SHANGHAI CAS PERSONNEL HOLDING SECOND JOBS

Shanghai JIEFANG RIBAO in Chinese 18 Aug 86 p 1

[Article by Wu Zhu Ming [0702 4376 7696]: "Over 600 Research Personnel at the Shanghai Branch of the Chinese Academy of Science Hold Second Jobs; This Fully Utilizes Their Research Potential While the Hiring Units Obtain Benefits in a Short Time"]

[Text] The Shanghai branch of the Chinese Academy of Sciences has disclosed that as of a few days ago, 685 of their research staff members are now employed in concurrent positions with enterprises under the branch's 15 research units in Shanghai and other provinces and municipalities as well as with academic institutions and other concerned departments. This is 12 percent of the branch's total research personnel. This type of concurrent appointment is coming to be of major significance in promoting technology transfers and the flow of information.

Analysis of this made a few days ago by concerned departments of the Shanghai branch shows that those personnel who hold second jobs are mostly in middle-level positions and are for the most part engaged by enterprises as technical advisors or as plant managers and directors (deputies). Next there is a small number of high-level research personnel who are employed mostly by academic institutions as part-time teachers. These concurrent positions involve 25 provinces and municipalities and 500 enterprises and units.

These second jobs for research personnel carry with them some obvious benefits for the hiring units. Due to past organizational systems and policies, any of the results from research units flow to enterprises in villages and small towns, which are technologically weak and incapable of realizing fully the benefits of these results. Their hope is that the institutes can be responsible for carrying the results through to the end technologically. After the Shanghai Silicate Institute transferred photochromatic glass production technology to Fengyang County in Anhui and Haimen County in Jiangsu, research personnel were also hired to provide long-term technical consultation for two enterprises, helping with the solution of technical problems and providing high-level management. Now, the annual output of these two county-managed enterprises has reached 10 million yuan in value, and they were praised by the scientific committees of those areas as a "golden phoenix flying from its nest." Luo Shi Wei [5012 1102 5517] of the Shanghai branch's

Plant Physiology Institute is a specialist in organizing operations which support research. He was hired by the Science and Technology Commission of the Guangxi Zhuang Autonomous Region as a technical consultant. Luo Shi Wei directed the test tube cultivation of sugarcane seedlings over a vast area of that region. By means of advanced S&T he changed the traditional methods of raising seedlings, which resulted in some rather impressive economic benefits.

Concurrent positions also enable some of the institutes' research staff to fulfill their potential. There is some concentration of middle-level research personnel in the institutes, with one project group often having seven or eight middle-level personnel. With everyone crowded together, there is no way for these to give free play to their work. This has been a personnel management problem for many years. Now the institutes have the organization and plan to arrange some second jobs for staff members so that some of the project groups' original personnel who are unknown to the public can realize their potential by doing important work in outside units. For example, an engineer from the Metallurgy Institute assumed a technical consultant role for a vacuum-coating machinery plant in Jiangsu's Wuxian County, and in just 10 days time he helped that plant solve installation and debugging problems on imported equipment worth 170,000 yuan. This allowed the successful employment of that equipment, which had previously lain unused for 10 months.

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NATIONAL DEVELOPMENTS

YAN DONGSHENG DISCUSSES CAS REFORMS

Beijing RENMIN RIBAO in Chinese 7 Sep 86 p 3

[Article by Chen Zujia [7115 4371 3946] and Yang Lianghua [2799 5328 0553]: "Yan Dongsheng Discusses Reforms at the Chinese Academy of Sciences; Unity and Openness Must Be the Fundamental Policy"]

[Text] While discussing reforms at the Chinese Academy of Sciences (CAS), Yan Dongsheng [0917 2639 3932] on 6 September stressed that the fundamental policy must be unity and openness.

The CAS executive vice president stated at a press conference on the 6th that all noted scientists, engineers, and technologists must be united nationally. This will assure that CAS is run well and is conforming more to what the central authorities require of CAS. Over the past 37 years, CAS has evolved into an 80,000-person team, with numerous research accomplishments. However, it has also become an independent department isolated from the outside world. This is totally unsatisfactory. To alter this situation, a policy of centrally developing S&T has been adopted. This will improve the efficiency of our mission of economic development, if CAS implements its reforms with a fundamental policy of unity and openness. This has been demonstrated repeatedly by research results.

Yan Dongsheng stated that CAS has "two flanks" with the world outside: one is its unity with the academic community, which has been reported previously in RENMIN RIBAO; the other is its unity with various ministries and commissions and with large and medium-sized enterprises.

He mentioned the joint relationship with the two petroleum groups under the Ministry of Petroleum Industry, which have attained some notable joint achievements. Besides this, the Lanzhou Geology Institute, the Paleontology Institute, the Geology Institute (Beijing), and others have been carrying out geological explorations jointly with the Ministry of Petroleum Industry, which have unearthed substantial petroleum deposits in northern Xinjiang. CAS, in accordance with the needs of the ministry, has developed a new model computer with improved scalar operational speed. It has also developed a variety of special materials for departments involved in oil extraction. CAS has decided to convert the Lanzhou (shen liu) [3334 3177] Mechanics Laboratory to a

research institute, under the joint direction of the Petroleum Ministry and CAS. It is actively carrying out some joint projects with the two petroleum groups.

The vice president noted that the advantages of unity are that it establishes a mutual feeling of trust, promotes mutual understanding, and fully develops each other's specialties through a unified tackling of problems. CAS hopes that unified efforts will open up solutions for the industrial production process, actively encouraging S&T personnel to participate in intermediate testing, and furnish data for the production plants. At the same time, it will welcome engineers and technicians in the industrial sector to take part in the work of CAS laboratories, especially in the work of intermediate-stage testing. From this they can resolve the technological process, work with a feeling of total confidence, and promote the transition of laboratories into large-scale production.

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NATIONAL DEVELOPMENTS

ZHEJIANG UNIVERSITY OPENS LAB TO OUTSIDERS

Beijing GUANGMING RIBAO in Chinese 2 Sep 86 p 1

[Article by Ye Hui [0673 6540]: "To Bring Disciplines to Fully Dominant Positions and To Advance Scholarly Exchange, Zhejiang University Is Opening Its Fluid Drive and Control Laboratory to Outsiders: the First Group of Six Visiting Scholars Will Be Permitted To Pursue Research Activities There Starting At Once"]

[Text] With the approval of the State Educational Commission, Zhejiang University will open its Fluid Drive and Control Laboratory to both foreign and domestic outsiders starting in September. The first group of six visiting scholars has received permission to go ahead with research activities there, for periods ranging from a year to a year and a half.

Opening the laboratory to foreigners is a major reform in the educational and research system of organization. According to the noted hydraulics expert Lu Yongxiang [6424 3941 4382], head of the university's Fluid Drive and Control Laboratory, regardless of whether the lab's equipment, technological strength, and scholarship are regarded as first-rate domestically, this will bring much international prestige as well.

At present this is the only post-doctoral fluid facility in China working on hydraulic systems. The laboratory's aim is seeking permission from the State Educational Commission to open up to the outside to develop high-level personnel more efficiently, promote scholarly exchange, and convert the lab into an open-style base for high-level teaching and research. After receiving approval, the university set up a special scholarly committee on the open research laboratory. This committee is composed of noted scholarly experts, both Chinese and foreign. As a first step, the committee announced for those working in this field an initial group of 12 research projects. It further decided that in the future an annual project guide will be published for use by foreign and domestic research and teaching personnel who may wish to apply for projects within the scope laid out in the guidebook. The laboratory has adopted many fund-raising channels to provide subsidies for researchers. Visiting staff can also do short-term research here at their own expense.

The lab will give priority to arranging and supporting basic and applied research projects which are innovative and have high potential for

application. Approved visiting scholars in the future can either be in charge of directing the research work on their own projects or working jointly with laboratory staff. The results obtained from a project will become the joint property of the laboratory and the visiting scholar's unit. Every 2 years the laboratory will announce a (ba si ge) medal and certificate in recognition of outstanding achievements by visiting scholars.

Lu Yongxiang told reporters that opening up the laboratory is a major reform in the educational and research system. Modern S&T are characterized by an overlapping of disciplines and mobility of personnel. The era of closing research and relying on the individual to complete major projects on his own is past. Opening to the outside smashes the old S&T system which kept departments, regions, and disciplines strictly separate, and it advances interlocking relationships which cut across disciplines, regions, and departments.

Lu Yongxiang made the further point that opening the laboratory to the outside is a type of talent and intellectual exchange: associating with other professionals, both foreign and domestic, brings with it many new ideas, viewpoints, and methods, while at the same time allowing the laboratory to pass along its own experiences. This exchange can definitely further the development of China's hydraulic technology. Opening to the outside can also bring advanced instruments and equipment into full use and greatly increase the equipment's use rate. In addition, it can provide a better working environment and conditions for many middle- and high-level S&T personnel who have no way to carry out important research projects.

Lu Yongxiang called upon all elements of society to support this reform. He urged that every unit within each industry permit their outstanding S&T workers to come to the laboratory to carry out middle- and high-level research activities. At the same time, he called upon even more of China's universities to open up their laboratories. In time, this will create throughout the entire S&T community the kind of dynamic, united, and harmonious scholarly atmosphere which will promote the development of China's S&T professions.

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NATIONAL DEVELOPMENTS

RETURNING STUDENTS WORKING CONDITIONS REPORTED

Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 14 Sep 86 p 4

[Article by Hua Nianlun [5478 1628 6544] and Wang Shihuan [3769 0013 3562]: "Xian Jiaotong University Creates Excellent Working Conditions for Students Returning From Abroad To Provide Ample Scope for Their Abilities; the Great Majority of These Will Become Our Academic Leaders at the Forefront of the Newly Emerging Disciplines"]

[Text] Xian Jiaotong University is putting an emphasis on making optimum use of students returning from study overseas (advanced study) by creating for them the excellent working conditions which will provide these students ample scope for their abilities. This in turn will advance the development of teaching and research at the university.

At present, of the more than 470 students of all types who have been selected for overseas study (advanced study), more than 190 have returned. They have applied the knowledge and experience gained abroad to their teaching and research, with the majority becoming leaders in learning and in the vanguard of newly emerging disciplines. Some have had spectacular results in their research. Lecturer Jiang Zhenghua [5592 2973 5478], while doing advanced study at the (Meng Mai) International Population Research Institute in India, received a gold medal award for outstanding achievement. Yao Xi [1202 3588] attained a Doctor of Philosophy degree in solid state science in less than 2 years of advanced study at Pennsylvania State University in the United States. Moreover, his doctoral dissertation received the 1982 U.S. award for the best science paper. His research findings in the area of relaxation circuit ceramic semiconductor materials was something of a breakthrough. After returning to China, he continued this type of research and made further progress.

After these students returned to the university from abroad, concerned leaders at Xian Jiaotong have listened personally to their reports and have heeded suggestions and requests concerning the school. In order to assure continuity of research work, these leaders have provided support in manpower, materiel, and finances. Where new disciplines are concerned, they have enthusiastically furnished assistants, have allocated and re-allocated a large amount of research funds, and have constructed appropriate laboratories and research offices. Professor Tao Wengquan [7118 2429 6898] spent 2 years at the

University of Minnesota in the United States doing research on the utilization of naphthalene distillation-simulated exchange heat patterns, while also studying numerical heat transfer. While he was still in the United States, authorities in Xian were already actively starting to construct an experimental station for him. In addition, the teaching and research section requested that he offer a course in numerical heat transfer for graduate students after his return to China. Just about the time he was returning to China, the distillation experiment station was basically constructed.

Xian Jiaotong has also granted exceptional promotions to those returned students who have made outstanding contributions in teaching and research. Yao Xi and Jiang Zhenghua were among eight who received these exceptional promotions. The school is also attempting to improve their living and working conditions, helping to remove problems at home which might hinder their work. The power engineering department sent graduate student Wu Yuyuan [0702 5940 6678] to England to pursue a Doctor of Philosophy degree, while his family of three remained in Sichuan. Prior to his return to China, the school transported his wife and children from Sichuan to Xian. This so pleased Wu Yuyuan that when the British invited him to stay on and work there, he politely declined and returned to Xian Jiaotong as scheduled

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NATIONAL DEVELOPMENTS

CHINESE UNIVERSITY OF S&T STUDENTS, FACULTY PRAISED

Beijing GUANGMING RIBAO in Chinese 19 Sep 6 p 2

[Article by correspondent Zhu Guanghua [2612 0342 5478] and reporter Xue Chang C1 [5641 2490 6101]: "Chinese University of S&T Puts Emphasis on Basic Theoretical Education, Trains a Group of Outstanding Students; This year, of 574 Undergraduate Students, 474 Enroll for Graduate Study Abroad"]

[Text] Of 574 undergraduate students at the Chinese University of S&T [CUST] this year, 474 have enrolled for a graduate study abroad, making the university the national champion for such enrollment rates. In a joint Sino-U.S. admissions examination for doctoral students in physics, 73 students nationwide, came up to standard in advance; of these, 33 were from CUST, including 7 of the top 10 qualifiers, as well as the top 2 in the competition.

Annually for the past several years, CUST has had more than 50 percent of its undergraduate students go on to graduate study, and this rate climbed to 84.8 percent last year. To quote a foreign magazine editorial, "China needs to train more 'tall trees that can catch the wind,' like the students from CUST."

In turning out the many talented people that it does, the key has been CUST's emphasis on basic theoretical education, which provides students with a rational structure to their learning and with a solid and substantial basis. They are skilled in experimentation, independent in thought, and capable of analyzing and solving problems.

In CUST's 5-year educational program, 3 and 1/2 years are devoted to instruction in basic courses. In order to establish these fundamentals, CUST very early on implemented a basic-course lecture system which provided a subsidy for professors appointed to teach these courses, thereby encouraging a larger number of highly professional teachers to go into this front line of instruction. At CUST, not only do the successful and prestigious professors want to be in the forefront, but younger instructors are no exception. Ninety percent of CUST's faculty is just entering their middle years, with the average age being about 40. Although this is not a well-known group of people, they are still solid in the basics, with a new structure to their knowledge, who are strong in initiative and dynamic in thought. They are flexible in their approach to university management and independent in their

selection of research topics, and they hold that the various schools of thought in their academic disciplines should contend, unhindered and unfolding freely. In both teaching and research this talent is showing itself, and many of these people are standing head and shoulders above the rest, becoming our academic leaders and the backbone of their professions.

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NATIONAL DEVELOPMENTS

DEVELOPMENT OF DOMESTIC ROBOT TECHNOLOGY VIEWED

Beijing RENMIN RIBAO in Chinese 11 Sep 86 p 5

[Article by Jiang Xinsong [5592 2450 2646] of the Shenyang Automation Institute of the Chinese Academy of Sciences: "My View on the Development of Robotic Technology in China"]

[Text] A "robot" is a type of high-level electromechanical machine, regarded in much of the world as representative of high technology. Those robots in use generally do not have a human appearance. The word "robot" originates from the Czech "robota," meaning "peoples' slave." It has now come to be a common term throughout the world. Not just China but practically everywhere else has chosen this transliteration.

The development of the "robot" goes back a long way. Since the Middle Ages a great many skilled craftsmen have created ingenious human-like toys and clocks, providing later generations with a wealth of guidance for designing and creating robots. In modern times, the first robot was successfully developed by the American George (Devol) in 1954; this was a programmable robot, with a memory function. In the 1980's, robots have become a powerful tool for accomplishing the automation of various kinds of manufacturing processes. People have divided them into two classes, i.e., industrial robots and remote-control production robots. The development of these two classes of robots can be divided into three stages: the first was that of command-repeating industrial robots and remote-control production robots; the second was that of industrial robots and remote-control robots which responded to an off-line program of sensory information; and the third is a system having many types of sensors which can, after receiving operational orders, under certain circumstances program itself independently. These are also called intelligent robots.

The areas of application of robots grow steadily broader. In the traditional area of application--machine manufacturing--the robot has from the start been employed as an all-purpose conveyor of equipment. It developed to the point where it could do arc lighting, spot welding, spray painting, brushing, sorting, casting, and various kinds of simple installation work. Many experts abroad have bent their efforts to applying robots to such various services as excavation, underwater work, space, nuclear industry, construction, disaster

relief, warfare and battlefield logistics,. With a bit more progress in robot technology, many fields which could previously not be developed due to human inability to enter them will attain unprecedented development.

China got into robotic technology relatively late: after our 10 years of upheaval were concluded, some research units and institutions of higher education established research organizations for the study of robotics. The government set up a (gui kou) management department, pushing forward the development of robot technology. For several years, there have been several hundred units which test-develop and manufacture nearly 2,000 manipulators of various kinds. The largest number of manipulators in use are in Shanghai; next comes Liaoning, then Jiangsu, Tianjin, Beijing, and other places. During the period of the Seventh 5-Year Plan, robotic technology will be arranged for tackling 76 key S&T projects, and a robot R&D base will be established in Shenyang.

Just off the top of my head, I have several suggestions concerning China's robot development:

1. Our emphasis should be on developing low-priced, simply constructed robots. Depending on enterprises' financial resources, they should progressively develop robots, keeping to three principles: that the enterprises themselves manufacture, maintain, and be able to make use of the robots. Organize a distinct engineering design team to research standards, patterns, and composition designs and strengthen development and production in departments which use the same robots.
2. There should be an emphasis on basic technology, especially stressing installation and production. "Watch the whole machine, not the parts" has been a pernicious idea in Chinese industrial production for a long time, and it must be changed. In the short run, there will be a domestic situation of difficulty in popularizing high-grade robots, so it is important that expenses be used to foster the basics, with planned publicity locations. This way, China's robot industry will take shape well.
3. This emphasis can conform to the environmentally altered second-stage robot's basic technology and related technologies. Because China's present industrial equipment has fallen behind, machinery orientation positions are off and machining tolerance is great, so it is inappropriate to make use of current industrial robots. If a robot were developed which came with simple sensors, and which could on a small scale revise its own program to respond to instructions, this would be a product which met the needs of the Chinese market.
4. Emphasize the development of special types of robots. While China's population is large, and its labor force is great, there still is no such thing as an industry which has all the labor it needs. Taking the mining industry as an example: because the working conditions are abominable, and the casualty rate high, current problems with the labor force are very prominent. This problem will be even more acute as the people's standard of living rises, and especially after only children enter the labor force. If we

are to solve this problem, it is imperative that we decrease the number of personnel in the mines to the point of achieving unmanned mining production. This makes robot development essential.

5. Pay attention to importing technology and extensively develop international cooperation.

Robotic R&D requires a process, and doing preliminary R&D well is extremely important. If high technology is to follow in the tracks of research, the concerted strength of everyone having anything to do with it must be organized. This then could be a totally responsible research entity. The purpose of this entity, from the standpoint of cross relationships, will be to take the various levels of fundamentals, applications, development and demonstration, etc. and to organize these into an organic whole. From the standpoint of direction, there would then be a united overall deployment all over the nation.

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PHYSICAL SCIENCES

'COUNTERWIND' CURRENT IN NORTHERN SOUTH CHINA SEA IN WINTER

Beijing HAIYANG YU HUZHAO [OCEANOLOGIA ET LIMNOLOGIA] in Chinese Vol 16, No 6, Nov 85 pp 429-438

[Article by Guan Bingxian [4619 4426 6343] of the Chinese Academy of Sciences Oceanography Institute, Qingdao; Survey Research Report No 1242; manuscript received 2 December 1983]

[Text] Abstract: The results of the "South China Sea warm-current dynamics experiments" in February-March 1982 show that deep-water region winter-current fields in the northeastern part of the South China Sea take baroclinic currents as their main component. This article analyzes anew the sectional thermal data observed in winter in the northeastern part of the South China Sea in 1966-68 and 1975 to study the changing features of the distribution of this counterwind current. The analysis shows that the northeasterly counterwind current off Shantou is the most stable and strongest and that the current off the southeast of Hainan Island is also quite stable. In these two sections the length of time that the northeasterly current exists can reach 4 to 6 months or more. The winter east-west spatial measure can be 6 degrees longitude. But the thermal structure of these sections with corresponding current structure is very complex both horizontally and vertically. Apart from the northeastern part of the South China Sea, counterwind currents are very unstable. These currents are very similar to subtropical countercurrents.

Concerning the circulation system of the northeastern part of the South China Sea, we have previously pointed out that in offshore regions, especially the eastern Guangdong coast, in winter there are currents present towards the northeast, counter to the flow of the wind, called "South China Sea warm currents."¹ A few years ago, based on the observational data of the "Cape St. Mary" survey vessel during the "Kuro-shio joint survey" (CSK), I pointed out: "In the period when northeastern monsoons flourish the ocean currents of the northeastern part of the South China Sea are not entirely from the northeast toward the southwest but rather at these sections (for example, Shantou, Hong Kong, Shangchuan, and Xiachuan islands, and southeast off the Qizhou archipelago), especially in the deep-water regions of the southern half, there is in the winter a narrow, belt-like, and rather fast northeasterly current, counter to the wind flow." "At the region east of 116°E the northeasterly current is even more stable and stronger, with its southern boundary reaching to around 21°N. Consequently, the eastern Guangdong coastal northeasterly current is an important constituent part of the entire

northeasterly current of the northern part of the South China Sea and is not a countercurrent formed from local vortices."³ At the same time, I also pointed out some important features of the horizontal and vertical structure of the water temperature distribution which corresponded to this region and the South China Sea warm currents.^{3,4}

From 18 February to 7 March 1982 the Chinese Academy of Sciences' South China Sea Oceanographic Institute successfully carried out the "South China Sea warm-current dynamics experiment" in the powerful northeastern wind of the north-eastern region of the South China Sea. Off Shantou to the southeast, current meter buoy stations were placed in a 1,000-meter deep section, obtaining observation records over 7 continuous days under conditions of 7 to 8 with level-9 gust northeasterly winds. Seven strata of "subcurrents" (10, 50, 100, 200, 300, 500, and 800) all indicated northeasterly or northwesterly directions. The subcurrents obtained by a 24-hour continuous-current observation station offshore of Shantou showed, apart from the 10-meter strata being east-southeasterly, all the strata deeper than 10 meters flowed to the northeast. Consequently, it proved the existence of "South China Sea warm currents" which were the first geostrophic current fields discovered and it further proved the author's conclusions concerning these counterwind currents.³

Recently the research results of the Soviet oceanographer, Brekhovsky, et al., concerning "world ocean winter and summer sea levels and the climatic structure of surface gradient currents" have also provided strong evidence for proof that counterwind currents are present in the winter in the northern part of the South China Sea. Figure 1 of their article (Figure 1) clearly shows that the sea level falls from south to north during winter in the northern part of the South China Sea, in the south it is about 100 centimeters, and in the north it is 20 centimeters for a very great slope. The contour lines of this phenomena from the west at Hainan Island going east to Taiwan are roughly parallel and distributed from southwest to northeast. This tendency is entirely like the region of the southeastern part of the East China Sea east of Taiwan and has nearly the same distribution. Figure 3 of their article gives the surface-gradient current distribution of all oceans in the winter. In it the northern part of the South China Sea is almost completely a rather strong northeasterly current and is even somewhat stronger than that in the East China Sea and east of Taiwan.⁶

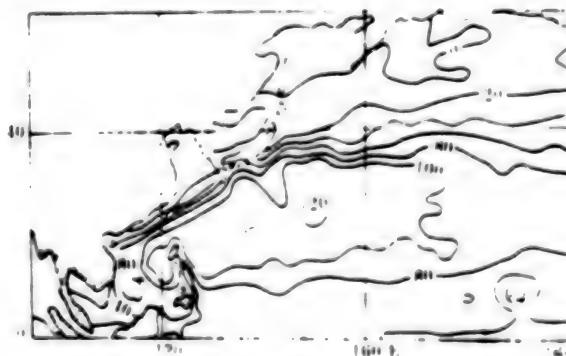


Figure 1. Sea-Level Distribution of the Northern Part of the South China Sea in Winter

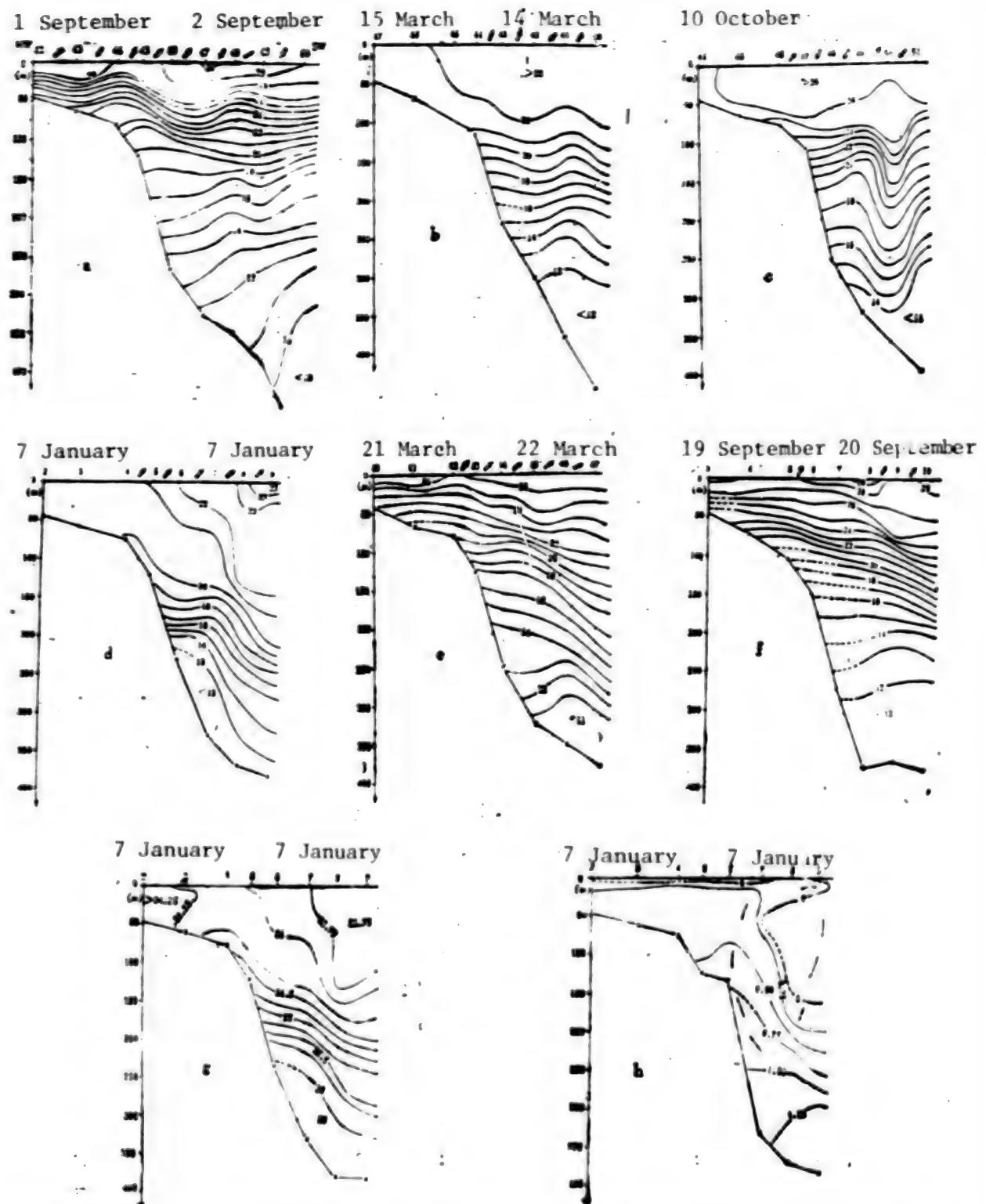
One of the major contributions of the "South China Sea warm-current dynamics experiment" was to use the results of ocean current observations to prove that the current fields of the deep regions of the northeastern part of the South China Sea in winter were primarily baroclinic, i.e., that geostrophic currents are well represented. Based on these results, this article will again use thermal data cited in the author's last two articles to discuss analytically some temporal and spatial distribution features of the winter counterwind currents related to these thermal fields.

This article stresses the analysis of data observed at four northwest-southeast directed sections at Shantou, Hong Kong, the Chuan Islands, and southeast of Hainan Island in 1966-1968, 1967, 1968, and 1975, respectively (source details are shown in Table 1).

Table 1.

Section position	Dates of observation	Observation unit	Data publication
1. SE of Shantou	9/1-2/66 3/14-15/67 10/10/67 1/7/68 5/21-22/68 9/19-20/68	Hong Kong Fisheries Research Station "Cape St. Mary"	CSK Data Report: Nos 78, 92, 138, 165, 203, and 205
2. ESE of Shanwei and Jiashi Bays	2/23-24/67	Japanese Climate Office "Ryofu Mary"	CSK Data Report: No 82
3. SE of Hong Kong	1/10-11/68	Hong Kong Fisheries Research Station "Cape St. Mary"	CSK Data Report: Nos 80 and 165
4. SE of the Chuan Islands	11/29-12/6/66	Hong Kong Fisheries Research Station "Cape St. Mary"	CSK Data Report: No 80
5. SE of Hainan Island	7/21-22/75 11/14-15/75 12/1-3/75	National Oceanography Bureau	

1. The six hydrothermal sections off Shantou from September 1966 to September 1968 are shown in Figures 2a-f. The positions of these sections and their distance from the stations were basically fixed and did not change. The density (σ_t) section on 7 January 1968 is shown in Figure 2g. Comparison of Figures 2d and 2g show that in regions farther from shore, the distribution of the density fields and the thermal fields tend to be nearly the same. Thus the thermal field can be substituted for the density field to analyze changing distribution tendencies of geostrophic currents.



Figures 2a-h. Temperature ($^{\circ}\text{C}$), Density (σ_t), and Phosphate ($\text{PO}_4\text{-P}$, $\mu\text{g-at/l}$) Distribution of a Southeast Section Off Shantou

a. $T(^{\circ}\text{C})$, 9/1-2/1966, Observed by the "Cape St. Mary," based on CSK Data Report No 78

b. $T(^{\circ}\text{C})$, 3/14-15/1967, No 92
c. $T(^{\circ}\text{C})$, 10/10/1967, No 138

d. $T(^{\circ}\text{C})$, 1/7/1968, No 165

e. $T(^{\circ}\text{C})$, 5/21-22/1968, No 203

f. $T(^{\circ}\text{C})$, 9/19-20/1968, No 205

g. σ_t , 1/7/1968, No 165

h. $\text{PO}_4\text{-P}(\mu\text{g-at/l})$, 1/7/1968, No 165

The arrows above the horizontal coordinates represent directions of the near-surface speed component crossing the section estimated based on temperature distribution. Of these the solid arrows indicate the near-surface maximum-average current velocity between two stations, that is, the place of the current (speed) axis. From the figure we can see that in these 2 years for the deep-water regions of the section southeast of Shantou the current direction was primarily to the northeast, especially in winter and early spring. The northeast-directed current is even more obvious in March 1967 (Figure 2b) and January 1968 (Figure 2d) compared to the other times. Of these nearly the entire set of strata (0-350 meters) in January 1968 flowed to the northeast. The flow amplitude at this time was also broad compared to summertime (September 1966 and 1968, Figures 2a, f) and no southwest current appeared. At other times not only was the water level rising, but the deep and bottom strata had southwest-directed currents. In September 1966, the deep-water portion at 150 meters and below nearly all flowed to the southwest. But the flow axis position was rather stable, mostly located between two observation stations at around 350 meters (i.e., directed offshore between stations 6-7 and 7-8, about 60-110 nautical miles from shore). Therefore, a northeast flow is present in winter in deeper areas of the section off Shantou during these 2 years. It flows counter to the wind in winter and the flow potential and amplitude are stronger than in other seasons.

We can also see from the temperature distribution graphs of Figures 2d-f that for the isothermal lines appearing in severe seasons the distribution tendency from the coast out to sea going downward is quite stable. Apart from upper stratification gradually manifesting with increase of atmospheric temperatures (from January to May to September) and isothermal lines directed toward shore and downward, produced in deep and bottom strata near the continental slope, the distribution tendency of principal thermoclines (14°C - 20°C) hardly changes (of course, the downward slope tends to weaken). Therefore, the weaker, broader northeastern currents observed in the first week of January 1968 had spatial measures (breadth) of about 50 nautical miles and the period length change also could reach or exceed half a year.

In these 2 years the southwest current of deep-bottom strata was broadest in September 1966 (Figure 2a). Except for specific regions, strata at 150 meters and deeper almost all flowed southwest. September 1968 (Figure 2f) also had similar conditions. This again demonstrates that the traditionally held idea that in summer southwestern wind season strata from the surface to the deep bottom in the northern part of the South China Sea all flow northeast is just not in agreement with the facts. Therefore, the relationship between the trend of lower thermoclines which are connected together with the basic current fields in the northern part of the South China Sea and seasonal winds is sometimes not clear or the reverse." An example of the above is the opposite condition of summer current fields and southwestern seasonal winds. Of course, the January 1968 current field is an example of being exactly opposite to the northeastern seasonal winds. Thus the relationship of basic current fields located in deep-bottom strata here to surface air seasonal winds is not so simple as traditionally conceived but rather is quite complex.

From Figures 2a-f we can also see that in the deeper regions of the northern part of the South China Sea the thickness of the upper homogeneous strata is greatest in January, reaching around 150 meters, down to 100 meters in March. May stratification is already very obvious with homogeneous strata only about 20 meters thick. September stratification is still extremely obvious with the homogeneous strata also only around 20 meters and by October the quickly increasing thicknesses can reach 50 meters or greater. Changes in upper homogeneous-strata thickness is closely related to seasonal wind strength and at the same time is also influenced somewhat by atmospheric changes.

2. If we make a comparison of the survey results on 10-11 January 1968 of a southeast section off Hong Kong (see Figure 3) with those on 7 January 1968 of a southeast section off Shantou, one can see that the hydrothermal structures are very similar. In the section off Hong Kong, the above 22°C upper homogeneous-strata range is broader (expanding from 30 to 50 nautical miles) and the depth could also get to about 150 meters. This broad, deep homogeneous strata is a subtropical "fuju" zone and the northeasterly current is the current field corresponding with this. The position of isothermal lines below the homogeneous strata and the distribution tendency downward from shore to sea are also similar to the section off Shantou. The current axis is also located between two stations at 300-plus meters deep. What is different is only that there appears a southwest current on the left side of the current axis of the section off Hong Kong. This is related to the deepening of the upper homogeneous strata there. Thus speaking of the conditions of these two sections at this one time, this counterwind northeast current can extend in an east-west direction at least a couple degrees of longitude, that is 200-plus kilometers.

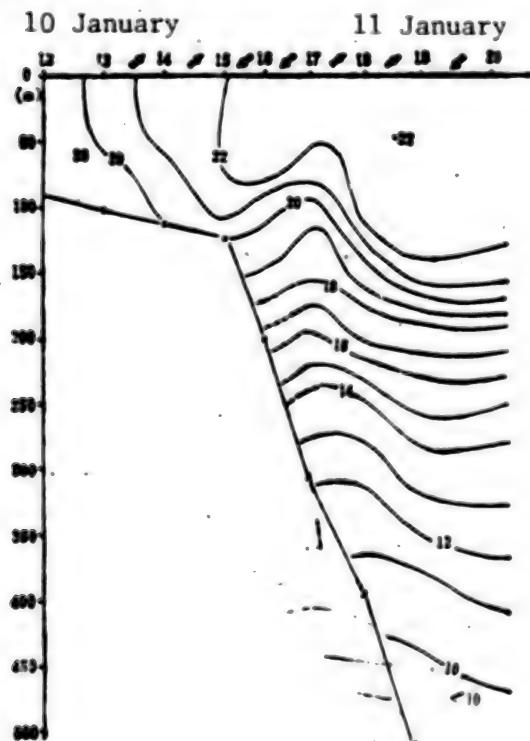


Figure 3. Temperature ($T^{\circ}\text{C}$) Distribution of a Section Southeast From Hong Kong on 10-11 January 1968 (observed by the "Cape St. Mary," according to CSK Data Report No 165)

3. Similar conditions also can be noted for the two southeast thermal sections of Hong Kong and the Chuan Islands in November-December 1966 (see Figure 4). The section off Hong Kong was observed on 24-25 November while the deep-water portion of the section off the Chuan Islands was observed on 5-6 December. These two sections are about 2 degrees longitude apart or 200-plus kilometers. On these two sections (except for the section off the Chuan Islands 350 meters or deeper), the isothermal lines follow the continental slope upwards sticking up to form a dome shape and the tendencies of the isothermal lines on the right side downward from northwest to southeast are very similar. The strata near the surface are all homogeneous water warmer than 25°C. Besides the extremely small dome shape on the left side, the northeast current of the right side of the section off Hong Kong is quite strong. In both of these sections the current axis is located between two stations exceeding 450 meters in depth. The maximum thickness of the upper homogeneous strata of the section off Hong Kong can reach 80 meters while that for the Chuan Islands can be 150 meters. This difference is primarily because the deep-water section off the Chuan Islands was observed 10 days after the observations of the section off Hong Kong. At that time the northeastern wind was stronger and the air temperature lower, causing the vertical mixing to be more severe. From a comparison of the position of a single isothermal line on the two sections we know that in this time period the isothermal line was depressed about 60-70 meters. From this feature of the distribution of these two thermal sections being very similar, we believe that the two sections are the same body of water at different times. Therefore this northeast current, which corresponds with the temperature distribution, has an east-west spatial measure of at least 200-plus meters.

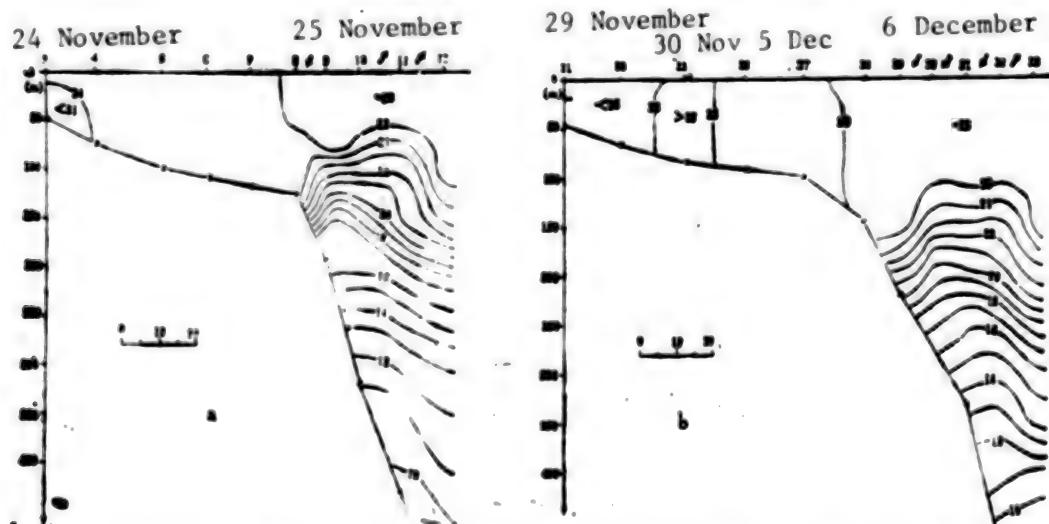


Figure 4. Temperature ($T^{\circ}\text{C}$) Distribution of Sections Off (a) Hong Kong and (b) the Chuan Islands
Observed by the "Cape St. Mary," according to CSK Data Report No 80

(a) 24-25 November 1966

(b) 4 November-6 December 1966

4. Concerning the conditions of the rectangular water region southeast of Hainan Island, just as the author pointed out,⁴ in the period from April 1975 to December 1976, there was present almost the entire year a current from southwest to northeast in the geostrophic current fields in this section. The speed of this current is fastest in fall (October and November), with the greatest speed between two stations 40 nautical miles apart reaching 50-80 centimeters/second. Figure 5 gives the temperature distribution of this section southeast from Hainan Island in 1975 for summer (21-22 July), fall (14-15 November), and winter (1-3 December). Apart from the near-surface strata, the tendency of the 400-meter and shallower isothermal lines ($\geq 10^{\circ}\text{C}$) to take station No 3 as the peak, dropping off to both sides, is very noticeable. Moreover, basically the same slope is maintained at least 4 months or more. To the right side of station 3 is primarily a northeast current; the current axis is located between stations 5 and 6; and the maximum current amplitude width can get to be 4×40 nautical miles. To the left side of station 3 there appears a southwest current. In winter, due to upper homogeneous strata deepening (reaching 75 meters) the southwest current of the near-surface strata to the right side expands between stations 3 and 4. But the strata deeper than 150 meters still flow northeast and their current amplitude is quite broad. Consequently, the water temperature structure of this second half of the year in Hainan Island's southeast region and the northeast current related to it is sustained from summer straight through, going through fall and winter basically stable. If we take the distribution of the $10-15^{\circ}\text{C}$ isothermal line on the right side of station 3 to be representative of this northeast current then in April, apart from turbulence of the near-surface strata caused by changes in air temperature and wind conditions, current conditions fundamentally do not change.

5. Of the winter northeast counterwind currents manifest in the temperature distributions from Shantou, Hong Kong, the Chuan Islands, and the rectangular section southeast of Hainan Island, that is, the geostrophic current fields described above, the one off Shantou is the stablest and strongest, the one in the southeast section off Hainan Island also being rather stable. In these two sections, the period of time that the northeast current is present, including the winter season, can attain 4 months to half a year or more. In the other sections (such as off Hong Kong and the Chuan Islands) the length of time it is present is still difficult to judge due to insufficient data. But sometimes the currents there are also very strong. For example, see the results of observations on 24-25 November 1966 and 5-8 December 1966.⁵

With respect to the spatial measure of this northeast current, in observations of January 1968, four successive sections all had a $22-23^{\circ}\text{C}$ vertical homogeneous strata with the left side all northeast current, so the west-east spatial measure can get to 6 degrees longitude, that is 600-700 kilometers. In other multiple observations (such as November-December 1966), the west-east spatial measure was at least 2 degrees longitude or about 200 kilometers.

6. This sort of large-scale and long-sustained thermal structure and corresponding northeast current is a geostrophic current with very strong baroclinity. The upward tendency from the left side (southeast) toward the right (northwest) of the isothermal lines is the result of maintaining geostrophic

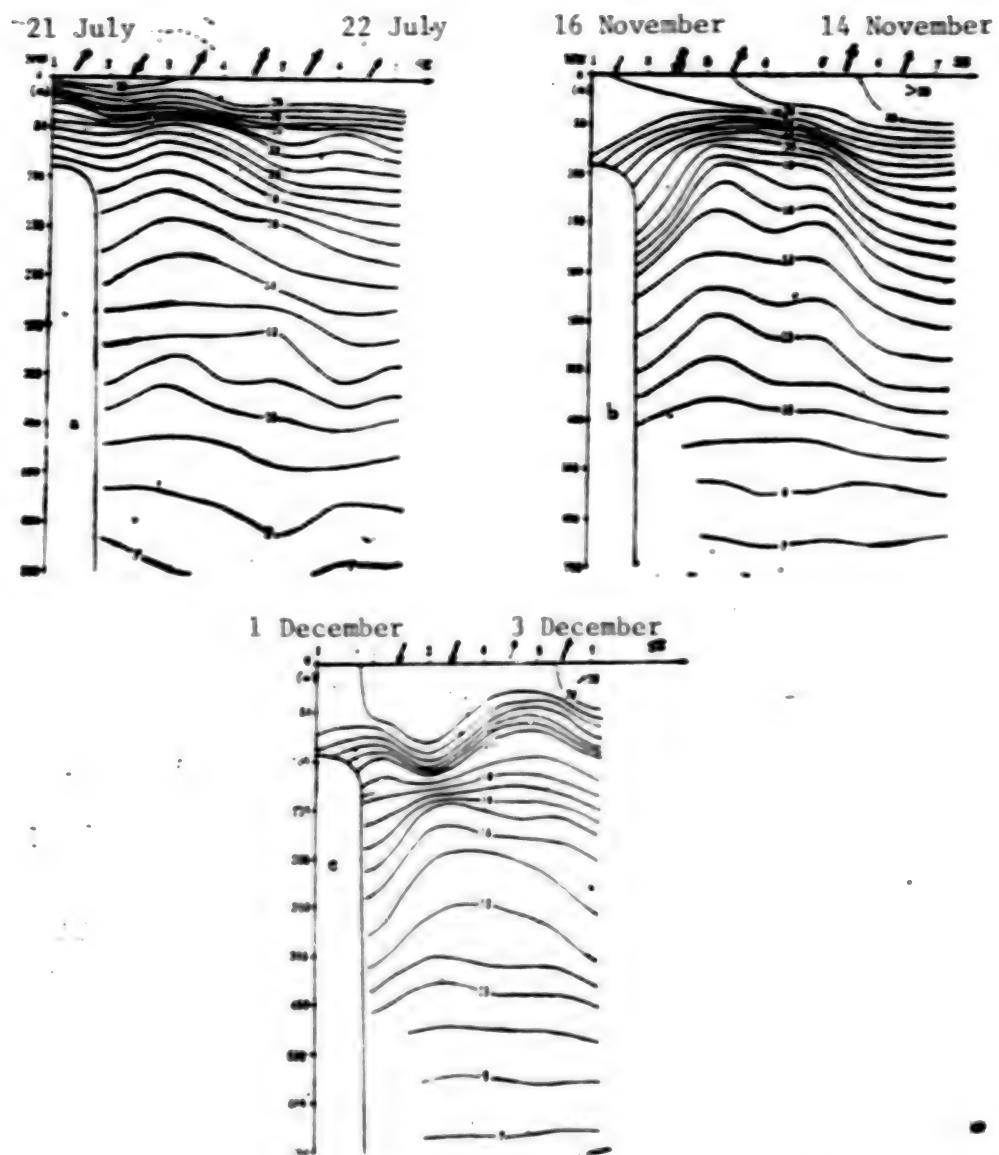


Figure 5. Temperature ($T^{\circ}\text{C}$) Distribution of Sections Off Hainan Island
 (Vectors between two stations represent surface current direction and black solid vectors represent stronger currents)

(a) 21-22 July 1975

(b) 14-15 November 1975

(c) 1-3 December 1975

equilibrium (Coriolis force equal to the pressure gradient force). Of course, this sort of phenomena of isothermal lines tending leftward and upward is also adapted to the vertical circulation of horizontal current directions, that is, when the left-side water produces a rising motion, the left-side produces a falling motion. This can be proved not only from temperature and density (σ_t) distribution but is even more clearly seen in the distribution of phosphate and silicate.

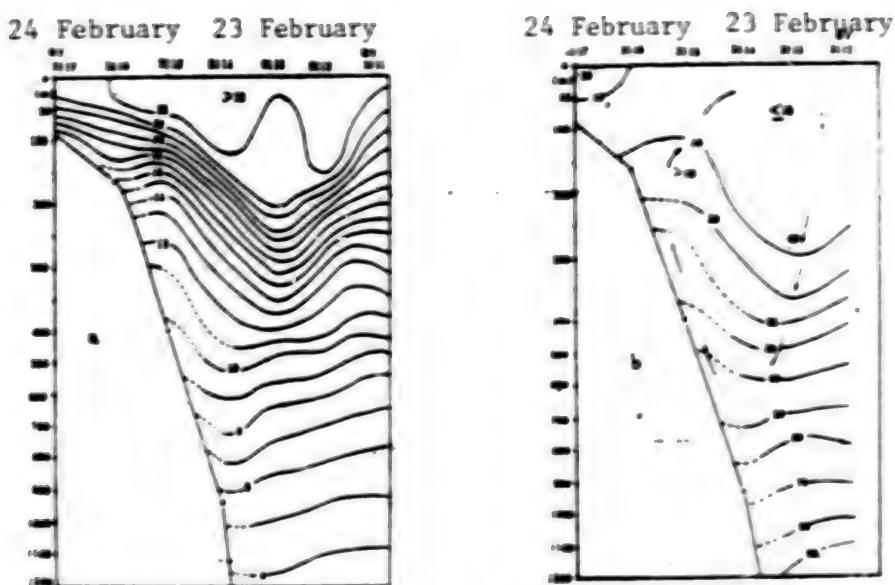


Figure 6. Distribution of Temperature (a. $T^{\circ}\text{C}$) and Phosphate (b. $\text{SiO}_4\text{-Si}$, $\mu\text{g-at/l}$) of a Section East-Southeast of Shantou and Jieshi Bays
23-24 February 1967 ("Ryofu Maru" observed, according to CSK Data Report No 82)

Figures 2g and 2h are the σ_t and $\text{PO}_4\text{-P}$ distribution on 7 January 1968 of the section southeast of Shantou and Figures 6a and 6b are the T and $\text{SiO}_4\text{-Si}$ distribution on 23-24 February 1967 of the section east-southeast of Shantou and Jieshi Bays. We can see that the distribution of phosphate and silicate tends to be the same as the distribution of temperature and density. The nutrient salt content distribution has a tendency to fall following the continental slope--from the outer apron of the continental shelf downward. This illustrates that the deep-strata water (greater density) has a tendency to climb following the continental slope--from the outer apron of the continental shelf but on the side facing the sea, the near-surface strata is a vertically homogeneous stratum and the nutritional-salt content increases from this deep stratum according to the depth. This shows that near-surface stratum water is falling, forming the vertical circulation represented by the arrows in the figures.

7. The thermal structure of the sections discussed above and the distribution of currents corresponding to them, both in the horizontal or vertical direction, are extremely complex and the shearing of northeast currents with southwest currents is also very great. In the section southeast of Shantou the situation is as follows: in 2 years of basically continuous observations (total of six times), although the northeast current was relatively stable and strong, the changes were also rather great. Below, we again refer to the conditions of the section southeast of Hong Kong and the Chuan Islands to reveal the severe changes of the thermal structure (and consequently the current distribution). In the two sections on November-December 1966 discussed before (Figures 4a and 4b), the distribution of isothermal lines went from northwest

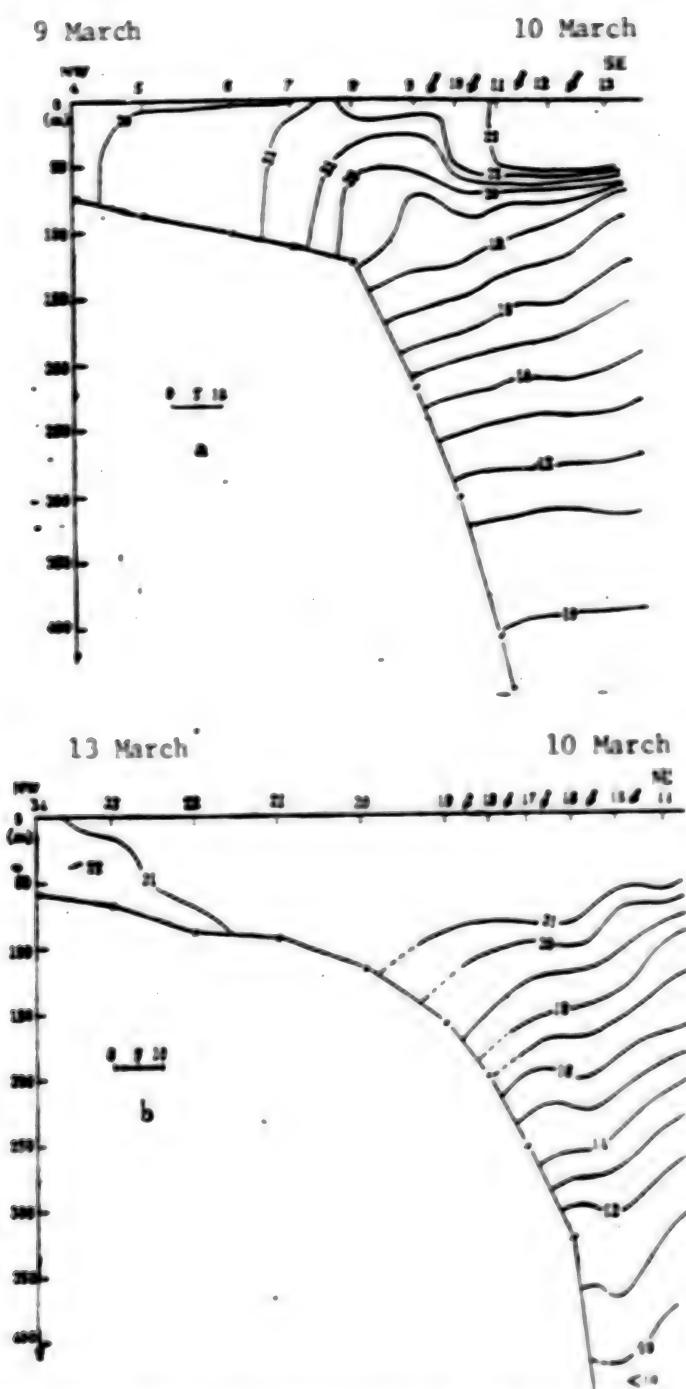


Figure 7. Temperature ($T^{\circ}\text{C}$) Distribution of a Section Southeast of Hong Kong and the Chuan Islands (According to CSK Data Report No 92)

- (a) Hong Kong 9-10 March 1967 observations
- (b) Chuan Islands 10-13 March 1967 observations

to southeast and consequently the major feature of the currents was from southwest currents toward the northeast. But in the observations of the same two sections on 9-13 March 1967 there appeared a nearly entirely reversed thermal structure and a corresponding current distribution. From Figures 7a and 7b it can be seen that in water at the 400-meter strata or above, with reference to the isothermal line distribution we can say that the major feature is that they tend entirely downward from southeast to northwest and consequently the currents nearly completely flow from northeast to southwest. After just 3 months the isothermal lines turned nearly 90° clockwise. The dynamic reasons for this sort of change deserves deeper study.

Changes in the thermal structure and current distribution of the outer apron of the continental shelf-continental slope region of the northern part of the South China Sea are very obvious. Thus, this winter counterwind current, except in the northeastern part of the South China Sea (i.e., the area off Shantou) where it is more stable, is not very stable in the other regions and sometimes it can change very greatly. Thus on this point also, it is very similar to the subtropical countercurrents discovered by Yoshida, that is, both are perhaps a wind of flow in stability, persistence, and continuity with "close or complete" semipermanence.³

Periodic reexamination of the form and causes of variation of the thermal structures of the various sections discussed above will be necessary and greatly beneficial to clarifying the formation mechanism of South China Sea warm currents.

FOOTNOTES

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2. Guo Zhongxin and Huang Yuting, "The Effect of Northeastern Monsoons on South China Sea Warm-Current Zone Temperatures: Preliminary Analysis of the Results of the South China Sea Warm-Current Dynamics Experiment," "Compendium of Paper Abstracts of the Third National Hydrology and Meteorology Scholarly Discussion," 1982, Vol 2, pp 35-36.
3. Guan Bingxian, "South China Sea Warm Currents: A Counterwind Current in the Sea Off Guangdong," HAIYANG YU HUZHAO [OCEANOLOGIA ET LIMNOLOGIA] in Chinese Vol 9 No 2, 1978, pp 117-127.
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5. K. Yoshida and T. Kidokoro, "A Subtropical Countercurrent (II). A Prediction of Eastward Flows at Lower Subtropical Latitudes," J. OCEANOCR. SOC. JAPAN, Vol 23 No 6, 1967, pp 231-246.
6. A.H. Brekhovskikh, Yu. L. Lenir, and T.V. Shakhanova, Klimaticheskaya Strukturna Urovnya; Poverkhnostnykh Gradienykh Techenny Mirovogo Okeana b Letniy; Zimniy Sezony OCEANOLOGY, 23 (2), 1983, pp 217-222

PHYSICAL SCIENCES

NUMERICAL INVESTIGATION OF 3-DIMENSIONAL SEMIDIURNAL TIDAL WAVES IN TAIWAN STRAIT, ADJACENT AREAS

Beijing HAIYANG YU HUZHAO [OCEANOLOGIA ET LIMNOLOGIA] in Chinese Vol 16, No 6, Nov 85 pp 439-450

[Article by Ye Anle [0673 1344 2867], Chen Zongyong [7115 1350 6978], and Yu Yifa [0060 1355 3127] of the Shandong Oceanography Academy, Qingdao; article received 4 March 1984]

[Text] Abstract: The research results of this article show that the three-dimensional semidiurnal tidal waves of the Taiwan Strait and adjacent regions are formed from the degenerate-rotation tidal system of the northern part and from the progressive tidal system in the south. The tidal-wave energy which enters the Taiwan Strait comes primarily from the northern system while the energy entering from the southern system is only one-tenth as much. Strong-current zones appear in the ocean off Fuzhou, in the Pescadores channel, and on the Taiwan shoals, and weak current belts are located north of the Taiwan shoals and the Pescadores archipelago. Vertical changes in the tidal waves exhibit a complexity like the tidal-current vertical structure of the offshore regions in the belt of the Taiwan Strait. Consequently, compared to vertically averaged current energy they more reasonably reflect the features of the actual tidal-current field.

The Taiwan Strait is the only passage which connects the East China Sea with the South China Sea. The topology of the strait and its surroundings is complicated (Figure 1). The depth of the ocean off the east side of the north end of Taiwan reaches over 1,000 meters. Toward the west the depth rapidly lessens and, reaching the west side of the north end of Taiwan, the depth is only a few dozen meters. The distribution of the strait's water depth is relatively uniform, averaging 60 meters. In the southern part of the strait there is the Pescadores channel and in the southwest the Taiwan shoals, which average only about 20 meters in depth. Going from the shoals southeast, the water depth quickly increases to a deep-water region of 1,000 meters and more with isobaths running northeast to southwest. Tidal waves of the Pacific Ocean enter the Taiwan Strait on two separate courses to the north and the south and are affected by the complex topography and the Taiwan coast. When they converge in the strait the result is to produce complex tidal-wave motions.

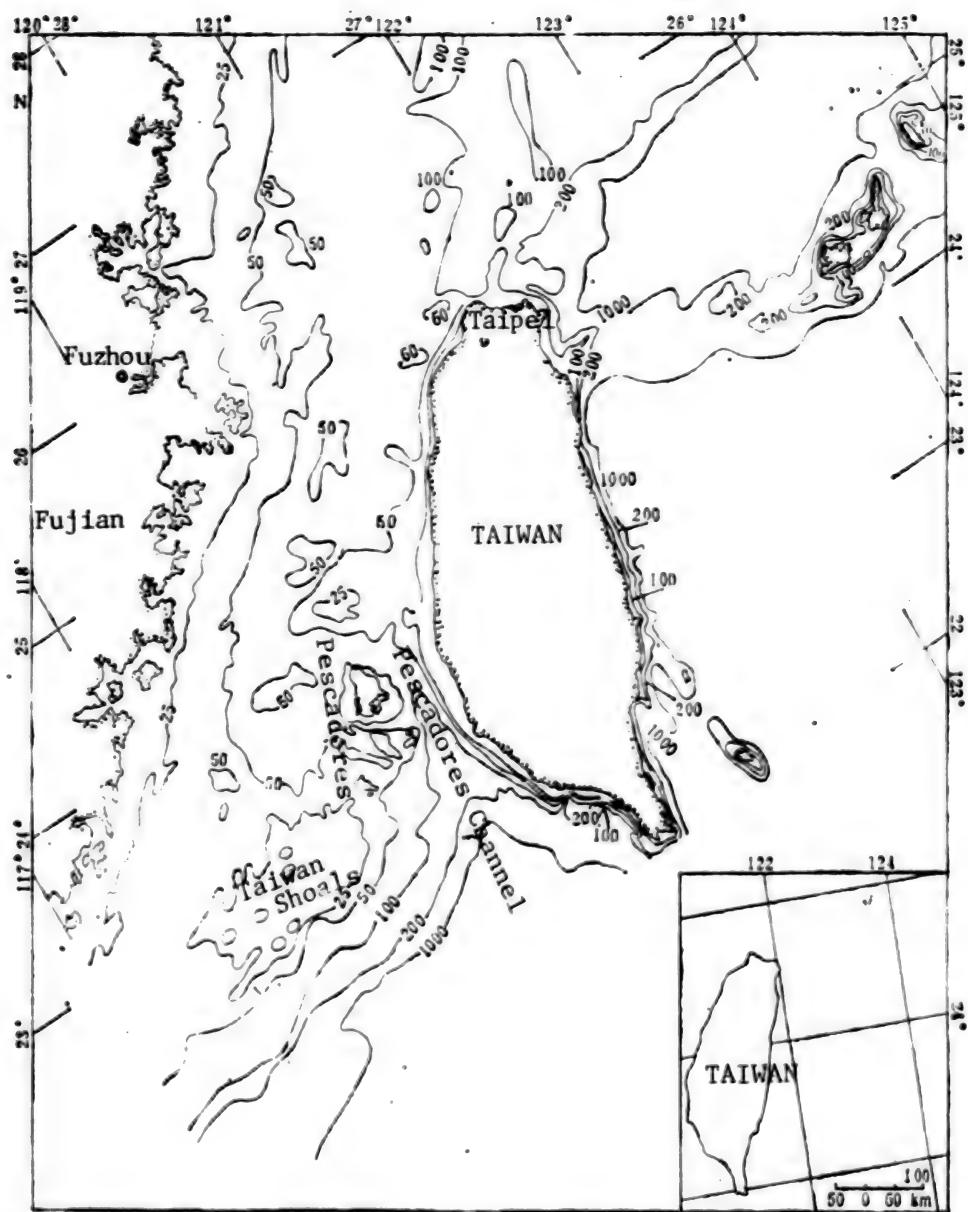


Figure 1. Topological Map of the Taiwan Strait and Its Surrounding Areas (depth in meters)

Due to the need to develop the oceans in recent years, Chinese marine science workers have carried out studies on tides and tidal currents in the straits,^{1, 5, 6, 8} providing a diagram of two-dimensional tidal-wave motions in the Taiwan Strait. (Reference 8 mentions a three-dimensional model but does not reveal its structure.)

As noted above, the tidal waves in the Taiwan Strait are the result of the combined action of two tidal-wave systems from the Pacific Ocean. Thus, from the point of view of studying the tidal-wave motion, it is appropriate to consider the problem with the tidal waves of the Taiwan Strait and its surrounding

regions as a whole. In the region which we discuss, there are changes ranging from the 20-plus meter deep Taiwan shoals to the several thousand meter deep-water zone. The total flow of a two-dimensional tidal wave cannot reflect the changes and complexity of the vertical structure of tidal currents in this region. In addition, dynamically an investigation of tidal-wave energy in the Taiwan Strait is significant. The ocean regions discussed focus on semidiurnal tidal waves. Consequently, this article plans to carry out study of three-dimensional semidiurnal tidal waves to attempt to provide diagrams of semi-diurnal tidal waves in the Taiwan Strait and to give the conditions of sources of energy, energy propagation, and dissipation.

1. Numerical Analysis of the Basic Equations for Tidal Waves

In a lefthand rectangular coordinate system with the z axis vertically downward, the basic equations of tidal-wave motion which consider the water's vertical turbulence cohesiveness friction are

$$\left. \begin{aligned} \frac{\partial u}{\partial t} - fv &= g \frac{\partial(\zeta - \zeta_0)}{\partial x} + A_z \frac{\partial^2 u}{\partial z^2} \\ \frac{\partial v}{\partial t} + fu &= g \frac{\partial(\zeta - \zeta_0)}{\partial y} + A_z \frac{\partial^2 v}{\partial z^2} \end{aligned} \right\} \quad (1)$$

$$\frac{\partial \zeta}{\partial t} + \frac{\partial}{\partial x}(hu) + \frac{\partial}{\partial y}(hv) = 0 \quad (2)$$

in which ζ_0 is the tidal height of the equilibrium tide (relative to an average water section); ζ is the tidal height of the actual tide (relative to an average water section); u, v are the components in the x, y directions of the tidal current, functions of x, y, z , and t ; \bar{u}, \bar{v} are the vertical average values of u, v ; f is the Coriolis parameter; h is the depth of water below an average water section; and A_z is the vertical turbulence cohesiveness friction coefficient, taken as a function of x and y . Since equations (1) and (2) are linear with respect to the functions ζ, ζ_0, u , and v , we can solve separately with respect to each harmonic "tidal component." The above functions can be expressed in the following form

$$\begin{aligned} \zeta &= \text{Re}[Y(x, y)e^{-i\omega t}] \\ \zeta_0 &= \text{Re}[Y_0(x, y)e^{-i\omega t}] \\ u &= \text{Re}[U(x, y, z)e^{-i\omega t}] \\ v &= \text{Re}[V(x, y, z)e^{-i\omega t}] \end{aligned}$$

in which $Y(x, y) = H \cos g + iH \sin g$, is the complex function of the actual component tide harmonic constants H and g ; $U(x, y, z) = H_x \cos g_x + iH_x \sin g_x$ and $V(x, y, z) = H_y \cos g_y + iH_y \sin g_y$, respectively, are the complex functions of the harmonic constants which correspond to them; and $Y_0(x, y) = \bar{H}$, is equal to the average amplitude of the equilibrium components tide. Applying boundary conditions

$$A_z \frac{\partial u}{\partial z} = A_z \frac{\partial v}{\partial z} = 0, \quad \text{for } z = 0$$

$$u = v = w = 0, \quad \text{for } z = h$$

and referring to reference [4] and [9] we can get the following tidal position equation:

$$R \left(\frac{\partial^2 Y}{\partial x^2} + \frac{\partial^2 Y}{\partial y^2} \right) + (S_i + S_q) \left(\frac{\partial Y}{\partial x} \frac{\partial A_s}{\partial x} + \frac{\partial Y}{\partial y} \frac{\partial A_s}{\partial y} \right) \\ + i(S_i - S_q) \left(\frac{\partial Y}{\partial y} \frac{\partial A_s}{\partial x} - \frac{\partial Y}{\partial x} \frac{\partial A_s}{\partial y} \right) \\ + (t_i + t_q) \left(\frac{\partial Y}{\partial x} \frac{\partial h}{\partial x} + \frac{\partial Y}{\partial y} \frac{\partial h}{\partial y} \right) \\ + i(t_i - t_q) \left(\frac{\partial Y}{\partial y} \frac{\partial h}{\partial x} - \frac{\partial Y}{\partial x} \frac{\partial h}{\partial y} \right) + i\sigma(Y - Y_s) = 0 \quad (3)$$

in which

$$R = -\frac{g}{A_s} \left[\left(\frac{\operatorname{th} jh}{2j^3} - \frac{h}{2j^2} \right) + \left(\frac{\operatorname{th} qh}{2q^3} - \frac{h}{2q^2} \right) \right] \\ S_i = -\frac{g}{A_s^2} \left(\frac{1}{4j^3} \operatorname{th} jh - \frac{h}{4j^2} \operatorname{sech}^2 jh \right) \\ S_q = -\frac{g}{A_s^2} \left(\frac{1}{4q^3} \operatorname{th} qh - \frac{h}{4q^2} \operatorname{sech}^2 qh \right) \\ t_i = \frac{g}{A_s} \frac{1}{2j^2} \operatorname{th}^2 jh \\ t_q = \frac{g}{A_s} \frac{1}{2q^2} \operatorname{th}^2 qh \\ j^2 = -i(\sigma - f)/A_s \\ q^2 = -i(\sigma + f)/A_s$$

Under conditions where $\sigma > f$, the tidal current computation formula is

$$\begin{aligned} U &= (C_u + iC_{u*})G_1/2j^3 + (C_{u*} + iC_u)G_2/2q^3 \\ V &= (C_u + iC_{u*})G_1/2ij^2 - (C_{u*} + iC_u)G_2/2iq^2 \end{aligned} \quad (4)$$

in which

$$G_1 = \frac{g}{A_s} \left(\frac{\partial Y}{\partial x} + i \frac{\partial Y}{\partial y} \right) \\ G_2 = \frac{g}{A_s} \left(\frac{\partial Y}{\partial x} - i \frac{\partial Y}{\partial y} \right) \\ C_u = \frac{\cos b z \operatorname{ch} b z \cos b h \operatorname{ch} b h + \sin b z \operatorname{sh} b z \sin b h \operatorname{sh} b h}{\cos^2 b h + \operatorname{sh}^2 b h} - 1 \\ C_{u*} = \frac{\cos b z \operatorname{ch} b z \sin b h \operatorname{sh} b h - \sin b z \operatorname{sh} b z \cos b h \operatorname{ch} b h}{\cos^2 b h + \operatorname{sh}^2 b h} \\ C_{u*} = \frac{\cos a z \operatorname{ch} a z \cos a h \operatorname{ch} a h + \sin a z \operatorname{sh} a z \sin a h \operatorname{sh} a h}{\cos^2 a h + \operatorname{sh}^2 a h} - 1 \\ C_n = \frac{\cos a z \operatorname{ch} a z \sin a h \operatorname{sh} a h - \sin a z \operatorname{sh} a z \cos a h \operatorname{ch} a h}{\cos^2 a h + \operatorname{sh}^2 a h} \\ a = \sqrt{(\sigma + f)/2A_s} \\ b = \sqrt{(\sigma - f)/2A_s}$$

Thereupon, first based on the boundary conditions we solve equation (3), getting the spatial distribution of the tidal position $Y(x,y)$ in the entire ocean zone, then based on formula (4) we seek the three-dimensional distribution of the tidal current.

For the region studied the y axis was taken at an angle of 32° with respect to a line of longitude, making it basically parallel following the coast of the Taiwan Strait. When computing tidal positions we used central differences and the boundary conditions were taken from English tide tables, related material of the IOS, and the data arranged in reference [8] as well as referring to numerical calculation results for the East and South China Seas.^{3,7} In the process of tidal-position and tidal-current computation, when the water depth exceeded 1,000 meters, the computed results were greater than the largest values expressed by the computer. To facilitate the work process it was stipulated that the vertical turbulence cohesiveness friction coefficients (A_z) of the calculated points which were larger than this depth be taken to be 50 square centimeters/second. In the process of computing tidal position we also did the following experiment: first we used actual observations on the Pescadores to control the computations. Then we carried out computations for the individual points which corresponded to the said archipelago. The results from these points fit rather well with actual observations on the archipelago. We did a comparison of the results of entire ocean zone calculations and observational data and discovered that they were satisfactorily identical. In order to show this point clearly we provide Tables 1 and 2.

Table 1. Comparison of Computed Results for Surface Tidal Current ($M_2 + S_2$) and Actual Observations¹

	Maximum current velocity (kn)	Maximum current direction
Mazu Archipelago Reg		
Computed results	2.4	Northwest-Southeast
Actual observations	2-3	Northwest-Southeast
Pingtan Island		
Computed results	2.2	Northeast-Southwest
Actual observations	2.5	Northeast-Southwest
Lishi Island		
Computed results	1.7	Northeast-Southwest
Actual observations	1.3	Northeast-Southwest
South Pescadores		
Computed results	1.9	Northeast-Southwest
Actual observations	2.0	Northeast-Southwest
East Pescadores		
Computed results	3.2	Northwest-Southeast
Actual observations	3-4	Northwest-Southeast

1. Actual data taken from the English "China Sea Pilot"

Table 2. Calculated Result and Observed Values for Vertical Changes in Tidal Current at Stations P and Q

Depth (m)	Station P					
	Maximum current (cm/s)		Maximum current direction (°)		Time of maximum current (h)	
Computed results	Actual observations	Computed results	Actual observations	Computed results	Actual observations	
0	55		143.6		2.94	
5	55		143.2		2.33	
10	54	52	143.3	122.0	2.91	3.1
15	50	52	143.7	122.1	2.80	3.0
20	44	48	144.6	122.1	2.50	2.8
25	34	43	146.0	122.2	2.01	2.6

Note: The flow direction took x direction as 0°, and y as 90°

Depth (m)	Station Q					
	Maximum current (cm/s)		Maximum current direction (°)		Time of maximum current (h)	
Computed results	Actual observations	Computed results	Actual observations	Computed results	Actual observations	
0	67		74.4		2.38	
5	66		74.4		2.36	
10	64	56	74.8	92.0	2.28	2.4
15	61	54	75.4	92.0	2.16	2.4
20	55	52	76.3	96.0	2.00	2.3
25	46	48	77.5	97.0	1.79	2.3
30	31	46	79.0	98.0	1.53	2.2
35	11	40	80.1	98.0	1.24	2.2

II. Tidal-Wave Propagation

Based on the spatial distribution of the M_2 and S_2 component tide positions, an M_2 cotidal diagram (Figure 2) and an S_2 cotidal diagram (Figure 3) were drawn up, respectively. From Figure 2 we can see that the M_2 tidal-wave motion in the Taiwan Strait and vicinity is constructed from two parts: the northern part is a degenerate-rotation tidal-wave system and the southern part is a progressive tidal-wave system. After the northern tidal wave enters the Taiwan Strait it first controls the northern region of the strait. Then to the south it combines near the Pescadores archipelago with the tidal wave which passed through the Pescadores channel and came north between Pescadores. At the same time the tidal wave which is traveling south continues to propagate southward in the strait and propagates to the southwest together with the tidal wave that bypassed the Pescadores and went over the Taiwan shoals. Due to the action of these two tidal-wave systems, the time of high tide on the east coast of the Taiwan Strait is gradually delayed by the two ends north and south toward the

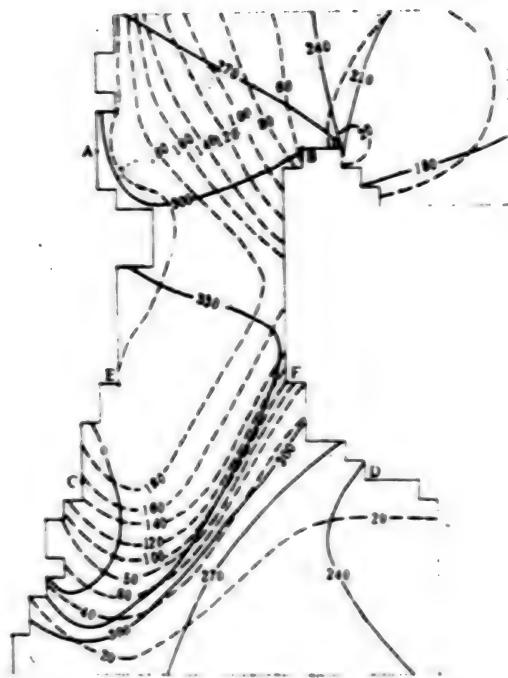


Figure 2. M₂ Cotidal Diagram

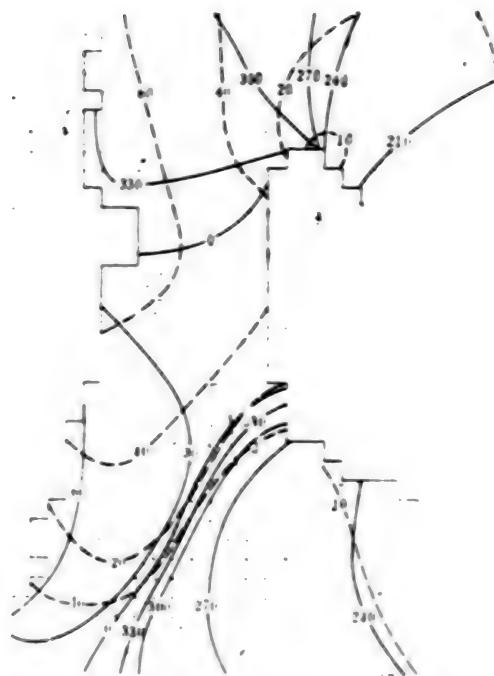


Figure 3. S₂ Cotidal Diagram

Broken lines represent equal amplitude lines (cm); solid lines indicate isotropic phase lines (°).

center. For example, the "isotropic phase line" of the sea off Taipei and off Gaoxiong is 300° while the isotropic phase line for the northern part of the Pescadores channel is 330°. That is, the high-tide time off Taipei and Gaoxiong is as much as 1 hour earlier than for the northern end of the Pescadores channel, while the sea off the Shandong Islands, of the areas we discussed, is the one where the time of high tide is the latest. The time at which it occurs is over 2 hours later than for the seas off Taipei and Gaoxiong. From Figure 2 we can also see that the isotropic phase lines in the belt of the Taiwan shoals basically tend to be the same as the equal-depth lines and also are more concentrated. This sort of crowding phenomena is a reflection of the reduction of the wave speed of the progressive tidal wave going from deep water to the shallow water of the shoals. The distribution of "equal amplitude lines" in Figure 2 has the following features: 1) The tidal range of the sea off Fuzhou reaches 4 meters or more. This is the region of greatest tidal range among those discussed and also the region where the latent capacity for utilization of tidal potential energy is greatest. 2) In the sea off Fuzhou, the direction of equal amplitude lines is nearly identical to that of the isotropic phase lines. 3) The Taiwan shoals, besides having equal amplitude lines crowded together, also display a clear lingulate distribution toward the southwest which is caused as a shallow-water release effect of the Taiwan shoals. Through the above observations it can be concluded that the M₂ tidal-wavemotion in the Taiwan Strait is primarily controlled by the tidal-wave system which enters the northern part of the strait while the tidal-wave system from the southern part only influences the region near the Pescadores archipelago.

Figure 3 shows similar features to Figure 2, illustrating that the motion of the S_2 tidal wave in the Taiwan Strait and vicinity is similar to the M_2 tidal wave. But in terms of strength, the S_2 tidal wave is much weaker than the M_2 wave. The amplitude of S_2 is only about one-fourth to one-third that of M_2 . As for the time of high tide, the time of high tide from the S_2 component at different places is 1 to 2 hours later than for the M_2 component tide.

III. Three-Dimensional Tidal-Current Structure

1. Planar Distribution of Tidal Currents

In the area discussed, based on computered results, we drew up tidal-current elliptic diagrams at the surface and a 40-meter stratum for M_2 component tide currents (Figures 4a and 5) as well as for S_2 component tidal currents (Figures 6a and 7). Now, with Figure 4a as an example, we discuss the planar distribution features of the fastest currents. First we turn our attention to the Taiwan Strait itself. In the northern part of the Taiwan Strait the direction of the major axes of the ellipses is northeast to southwest while in the southern part of the strait it is northwest to southeast. In the Taiwan Strait the region with the strongest currents are located near the Pescadores archipelago while in that area the currents in the Pescadores channel are the strongest (due to coastal influence), being as large as 4 knots. This is the strongest current zone in the areas discussed. For the southern areas of the Taiwan Strait, over the Taiwan shoals southwest of the Pescadores archipelago, the direction of the major axes of the ellipses is northwest to southeast. Because of the influence of the shallow water, the M_2 tidal current is also strong, second only to the current in the Pescadores channel at about 3 knots. However, the southeasterly direction of the Taiwan shoals is not the same as above the Taiwan shoals: in the deep-water zones the direction of the major axes of the ellipses is northeast to southwest and the current is very small. As seen from the equal-depth line distribution (Figure 1), the direction of maximum current above the Taiwan shoals intersects the equal-depth lines but in the deep-water zone to its southeast, the direction of maximum current is parallel to the equal-depth lines. Because the direction of the flood tide current and the direction of propagation of the tidal wave are the same, here again is manifest a tidal wave which enters from the Pacific via the Bashi Strait and primarily propagates toward the South China Sea along the deep-water equal-depth lines. Only a small portion traverses the equal-depth lines of the shallow water and, going northwest, enters the belt of the Pescadores archipelago and passes over the Taiwan shoals. With regard to the region north of the straits, the right side off the north end of Taiwan is a deep-water zone and, due to the obstruction of Taiwan, the tidal wave traverses the equal-depth lines toward the northwest entering the East China Sea. Consequently, the direction of the major axis of this M_2 ellipse is northwest to southeast. That the degenerative-rotation tidal waves of the north end of Taiwan enter the Taiwan Strait is shown by the feature of the ellipse's major-axis distribution forming a vortex shape in the sea off the north end of Taiwan. In this region the strong-current zone is located in the sea off Fuzhou (due to the result of the combined action of coastal topography and shallow water) with maximum currents attaining speeds over 2 knots. The maximum-current speed for M_2 of the seas off Taipei is more than 1 knot.



Figure 4

a. M_2 Tidal Current Ellipses Diagram
(Surface)

b. M_2 Tidal Current Isochronous
Diagram (Surface)

- indicates that the tidal-current ellipsis rotation direction is positive

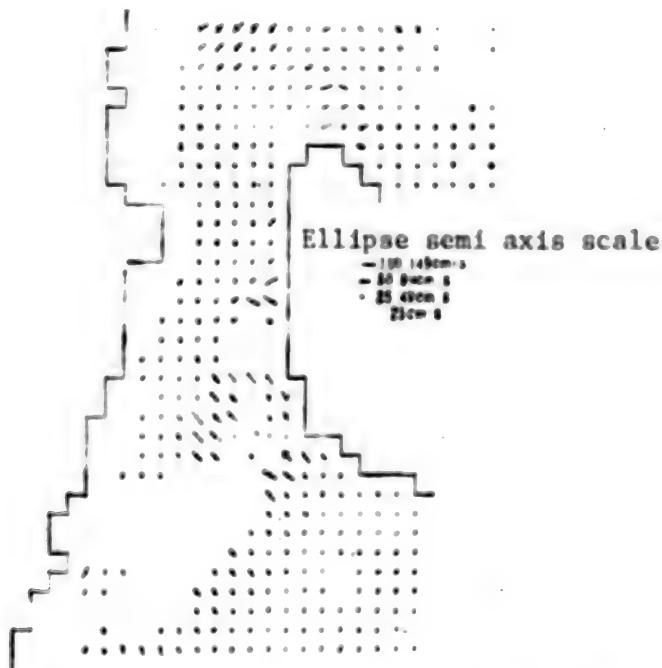


Figure 5. M_2 Tidal Current Ellipses Diagram (40-meter stratum)

- indicates that the tidal-current ellipsis rotation direction is positive



Figure 6a. S_2 Tidal Current Ellipses Diagram (Surface)

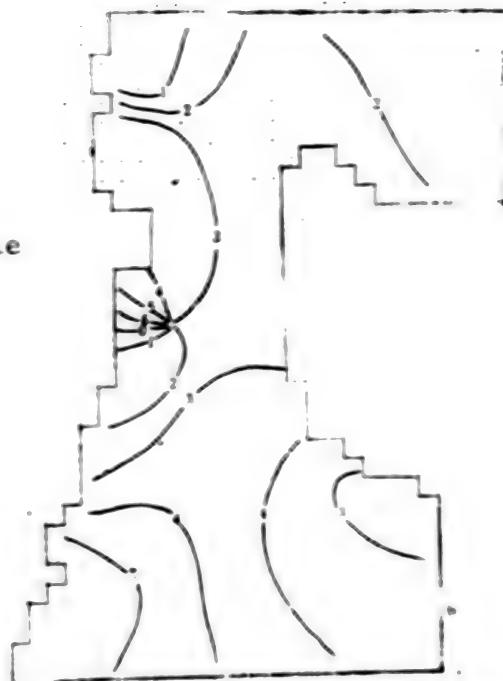


Figure 6b. S_2 Tidal Current Isochronous Diagram (Surface)

o indicates that the tidal-current ellipsis rotation direction is positive



Figure 7. S_2 Tidal Current Ellipse Diagram (40-meter stratum)

o indicates that the tidal-current ellipsis rotation direction is positive

Another special feature in Figure 4 is that there exists from the Pescadores archipelago and the Taiwan shoals to the north a weak-current belt running northeast to southwest and a boundary line running northeast to southwest and different from the tidal ellipse rotation direction. For the region above the boundary line the ellipse rotation direction is counterclockwise and below it is clockwise. These two zones with different rotation directions in the Taiwan Strait are zones where two different tidal systems have effective control and the boundary line between different directions of rotation and the weak-current belt is a reflection of the convergence of the two tidal systems. Figure 5 illustrates the distribution of 40-meter stratum M_2 tidal-current ellipses. The general features are the same as in Figure 4 but the degree of reduction of maximum current speeds relative to the surface has some differences and the changes in current direction are not uniform. This has a close relationship to the water depth. The features of Figures 6a and 7 are similar to Figures 4a and 5, only being much weaker in terms of strength. In addition, Figure 4b and Figure 6b separately show that M_2 and S_2 surface tides flow along isochronal lines. It can be seen that in the central part of the Taiwan Strait the two both have an accumulation point where the tides flow along isochronal lines. This is similar to the results of reference [6].

2. Vertical Structure of Tidal Currents

We calculated the vertical distribution of M_2 and S_2 tidal currents for the region discussed. Here we take the vertical structure of the M_2 tidal current of the cross section EF (see Figure 2) to illustrate the major features of the semidiurnal tidal-current vertical structure for the entire strait. Figure 8a shows the maximum current speed according to changes in depth for each calculation point of this cross section. In places where the water depth was less, the maximum current speed from the surface to the bottom gradually lessened and was reduced more quickly the farther down it went. In places where the water was deeper, the maximum current speed of the entire upper strata did not change much with depth but for the lower strata the speed was reduced. Figure 8b demonstrates the changes in the direction of maximum current with depth. The major features here are: 1) The direction of maximum current speed of the upper strata inclined to the right as depth increased and that for the lower strata inclined to the left with increased depth; 2) in the upper strata, in the process of inclining to the right, the deflection speed first increased from top to bottom then changed and decreased from top to bottom, finally entering the leftward-inclined lower strata, and there the speed of leftward deflection increased from top to bottom; and 3) in places where the water was deeper, the rightward-inclined stratum was thicker and in places where the water was shallower the rightward-inclined stratum was thinner. In Figure 8b there is a point worth noting: the maximum current speed direction change is not great. Even for the 229 stations with depths of over 40 meters the change of the bottom strata relative to the surface is only a few degrees. This is because the change of direction of maximum current speed with depth is related to the geographical latitude.² From Figure 8c we see that the major features of the change of time at which the maximum current velocity occurs versus depth are: 1) With increased depth it moves up; and 2) it increases with the rate of change in depth and with increasing depth, i.e., the farther down you go the faster it moves up.

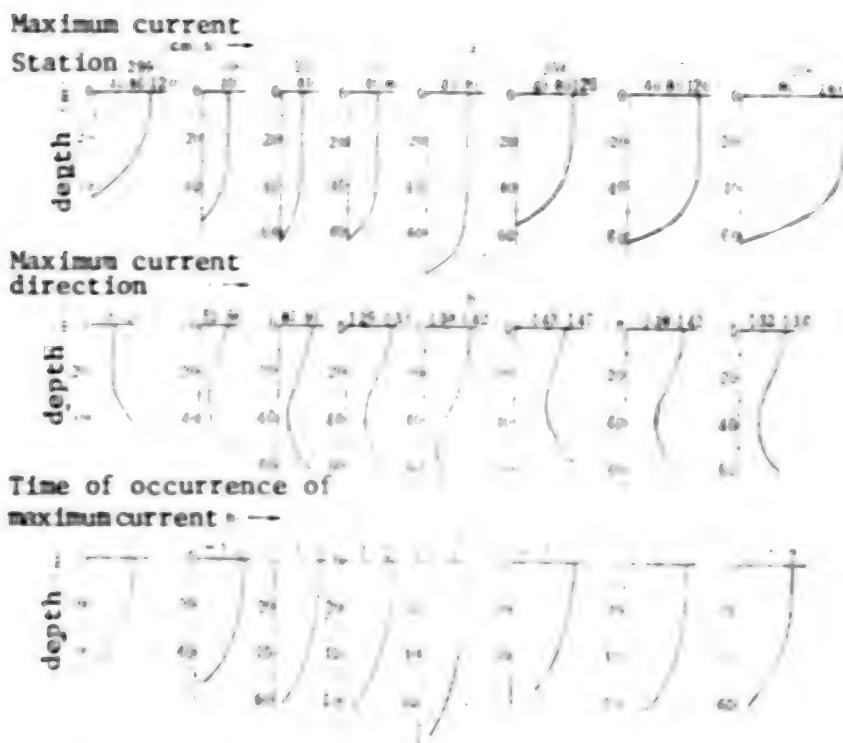


Figure 8. M_2 Tidal Current Vertical Structure of Cross-Section EF

- Vertical distribution of maximum current speed
- Vertical changes of direction of maximum speed
- Vertical change of time at which maximum speed occurs

ough this analysis of this cross-section with respect to the M_2 tidal-current vertical structure it can be seen that for shallow-water regions near the coast, a study of three-dimensional tidal-current structure is of assistance to advancing an understanding of the features of actual tidal-current fields.

IV. Source and Dissipation of Tidal Wave Energy

because the regions we have discussed are relatively small, the action of celestial-caused tidal forces can be ignored so the source of energy comes primarily from the Pacific Ocean. Separately selecting cross-sections AB and CD (see Figure 2) at the north and south ends of the Taiwan Strait, and using harmonic constants for tidal position and tidal currents, we calculated the average energy flow in a tidal-component period for a unit width at each station and the average energy which passed through the entire section. The results of these calculations are shown in Tables 3 and 4. The station numbers in the tables are arranged from the western to the eastern shore of the strait. According to the tables we see: 1) that the semidiurnal tidal-wave energy entering the Taiwan Strait through cross-section AB is much greater for stations near the west bank than for those near the east bank; and 2) the M_2 tidal-wave energy passing the entire cross-section is much greater than that

Table 3. Energy Per Unit Width at Each Station (ergs/s cm) and Energy Which Passed Through the Entire Section AB (ergs/s)

Station	454	455	456	457	458	459	460	461	462	463	Energy E through AB
Energy flow											
Tidal component											
M_2	0.874×10^4	0.3037×10^4	0.2359×10^4	0.2321×10^4	0.1754×10^4	0.1699×10^4	0.0961×10^4	0.1064×10^4	0.0845×10^4	0.0874×10^4	0.2821×10^4
S_2	0.6108×10^4	0.3513×10^4	0.2763×10^4	0.2518×10^4	0.1932×10^4	0.1975×10^4	0.1301×10^4	0.1632×10^4	0.1476×10^4	0.1593×10^4	0.3535×10^4

Table 4. Energy Per Unit Width at Each Station (ergs/s cm) and Energy Which Passed through the Entire Section CD (ergs/s)

Station	225'	226	227	228	229	230	231	232
Energy flow								
Tidal component								
M_2	-0.1273×10^4	-0.1187×10^4	-0.9983×10^4	-0.7566×10^4	-0.4906×10^4	-0.3891×10^4	-0.3272×10^4	-0.3100×10^4
S_2	-0.3989×10^4	-0.4442×10^4	-0.4114×10^4	-0.3465×10^4	-0.2585×10^4	-0.2420×10^4	-0.1912×10^4	-0.0713×10^4
Station	233	234	235	236	237	238	Energy E through CD	
Energy flow							E_{out}	E_{in}
Tidal component								
M_2	0.5065×10^4	0.0513×10^4	0.3323×10^4	0.4145×10^4	0.1405×10^4	0.0639×10^4	-0.1083×10^4	0.2852×10^4
S_2	0.2341×10^4	0.1109×10^4	0.2859×10^4	0.4262×10^4	0.1981×10^4	0.1064×10^4	-0.4464×10^4	0.2578×10^4

Note: A minus sign indicates energy flow from the strait to the outside.

for S_2 , which is only 12.5 percent of M_2 . (The energy of the M_2 component tidal wave passing through the cross-section AB input to the Taiwan Strait is 0.2821×10^{14} ergs/s, more or less the same as the 0.201×10^{14} ergs/s estimate cited in reference [11].) Table 4 shows: 1) that for stations near the west bank in cross-section CD, energy flowed from the strait to the outside and for stations near the east bank, energy flowed into the strait; and 2) that the energy passing through cross-section CD on the west side flowing out of the strait was much bigger than that flowing into the strait on the east side ($E_{out}/E_{in} = 3.8$).

Based on Tables 3 and 4, we further calculated Table 5 to get the situation for energy input, output, and dissipation for the Taiwan Strait. The ratio

Table 5. Semidiurnal Tidal-Wave Energy Input, Output, and Dissipation in the Taiwan Strait (ergs/s)

M_2	Input	AB	CD	S_2	Input	AB	CD
		0.2821×10^{18}	0.2852×10^{18}			0.3535×10^{18}	0.2578×10^{18}
	Out-put	CD	AB		Out-put	CD	AB
	0.1083×10^{18}	0			0.4464×10^{18}	0	
	Net input	0.1738×10^{18}	0.2852×10^{18}		Net input	0.3087×10^{18}	0.2578×10^{18}
	Total dissipated	0.2023×10^{18}			Total dissipated	0.3341×10^{18}	

of energy of M_2 tidal-component waves passing through AB to those passing through CD is $E_{CD}/E_{AB} = 38$ percent. That is, of the energy of M_2 tidal waves coming through AB, 62 percent is dissipated in the Taiwan Strait and the M_2 tidal-wave energy entering through CD is entirely dissipated in the strait. The total dissipation of M_2 tidal-wave energy in the Taiwan Strait is 0.2023×10^{18} ergs/s. The corresponding ratio of energy from S_2 component tidal-wave input through AB to that output through CD $E_{CD}/E_{AB} = 13$ percent. About 78 percent of the S_2 tidal-wave energy from cross-section AB is dissipated inside the strait. The total dissipation of S_2 tidal-wave energy in the Taiwan Strait is 0.3341×10^{18} ergs/s, which is about 17 percent of the total dissipation of M_2 tidal-wave energy. Finally, we should note that the semi-diurnal tidal-wave energy which is output through CD is dissipated in the ocean region near the Shandong Islands. Consequently, semidiurnal tidal energy is not input from the Taiwan Strait into the South China Sea. This is in agreement with the conclusion of reference [7].

V. Conclusion

1. The tidal-wave movements of the Taiwan Strait are the result of the combined action of a degenerate-rotation tidal wave system of the northern part and a progressive tidal-wave system of the southern part. The two tidal waves converge in the region of the Pescadores archipelago and the northwestern region of the Taiwan shoals and then propagate toward the southwest.
2. Strong currents appear in the Pescadores channel, on the Taiwan shoals, and in the ocean off Fuzhou. The strong currents in the Pescadores channel are influenced by the coastal topography. Those above the Taiwan shoals are affected by the shallow water there, and those off Fuzhou are the result of the combined action of coastal topography and shallow water.
3. The vertical structure of the tidal currents shows that consideration of total flow cannot reflect the changes and complexity of the actual tidal-current field structure.
4. Discussion of tidal-wave energy input into the Taiwan Strait provides a measure of the strength of the two kinds of tidal-wave systems. The semi-diurnal tidal-wave energy input from the northern end of the strait is

0.3174×10^{18} ergs/s while the semidiurnal tidal-wave energy input from the southern end (the part near the Taiwan coast) is 0.3110×10^{17} ergs/s, about one-tenth that input from the northern part. The total dissipation of semi-diurnal tidal-wave energy in the Taiwan Strait is 0.2357×10^{18} ergs/s.

5. This article used numerically calculated results to serve as boundary conditions for "water boundaries." Consequently, errors are unavoidable. More advanced studies await reliable observations done in this area.

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12966/9365
CSO: 4008/1003

PHYSICAL SCIENTIE

APPROXIMATE SOLUTION METHOD FOR MHD BOUNDARY LAYER EQUATIONS

Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese Vol 4
No 3, Sep 86 pp 306-312

[English abstract of article by Yan Hui [0917 6540], et al., of Zhejiang University]

[Text] This paper discusses an approximate solution method for the boundary layer equations of magnetohydrodynamic flow past a semi-infinite flat plate in the presence of a transverse magnetic field. The authors take solutions of ordinary differential equations to be approximate solutions of the partial differential equations in order to reduce a large amount of computing work. It is found that the approximate numerical solutions are in good agreement with the complete numerical solutions.

CSO: 4009/11

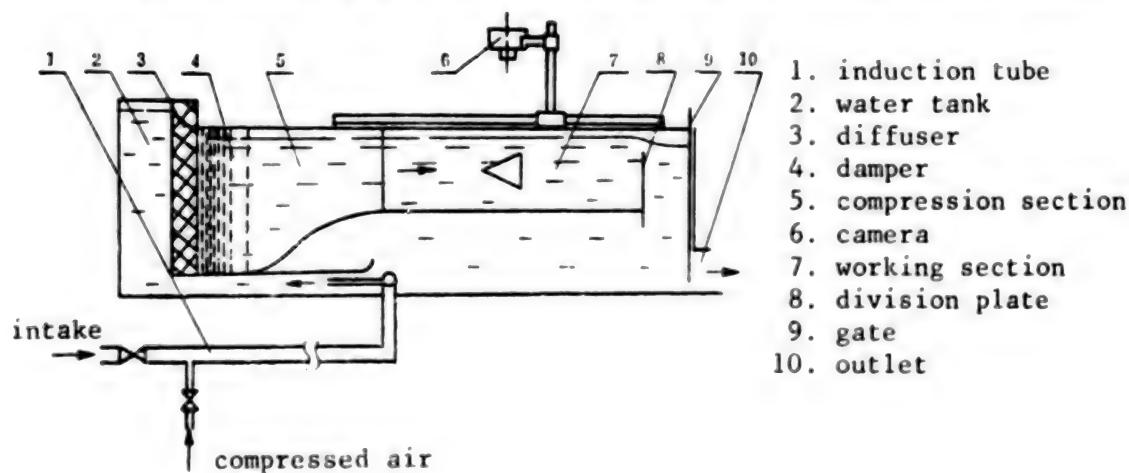
PHYSICAL SCIENCES

FLOW VISUALIZATION TECHNIQUE USING AIR BUBBLE METHOD AND SPECIAL INDUCTION-RETURN FLOW WATER TUNNEL

Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese Vol 4 No 3, Sep 86 pp 320-325

[English abstract of article by Wang Huawei [3769 0553 0251] of the China Aerodynamic Research and Development Center]

[Text] This article introduces an air bubble method for low-speed flow visualization in a water tunnel. An induction-return flow water tunnel is adopted, air is compressed into the induction tube by a compressor, and good air bubble visualization can be obtained in the test section. Some test results with this visualization method are given in this paper.



CSO: 4009/11

PHYSICAL SCIENCES

EXPERIMENTAL RESEARCH ON INFLUENCE OF IMPURITY ON AIR RADIATION

Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese Vol 4 No 3, Sep 86 pp 326-332

[English abstract of article by Li Hongde [2621 7703 1795], et al., of the Institute of Mechanics, Chinese Academy of Sciences]

[Text] This report presents experimental research at different temperatures and densities on the influence of impurities on radiation at spectral and integral radiation on air equilibrium radiation by using the radiometer in the low density shock tube. The experimental results are given at different conditions and a simple analysis has been made. The experimental results show that the influence of a small amount of the impurity on air equilibrium radiation is rather large; when the wake radiation field is computed, the influence of impurities on radiation must be considered.

CSO: 4009/11

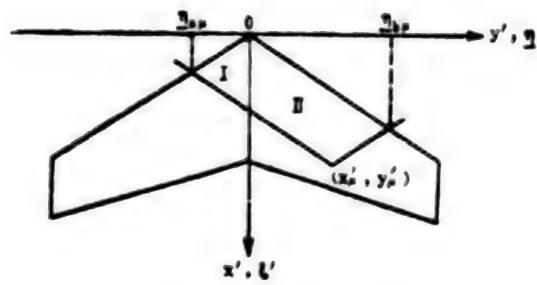
PHYSICAL SCIENCES

IMPROVEMENTS IN SUPERSONIC KERNEL FUNCTION METHOD AND ITS APPLICATION TO FLUTTER CALCULATION

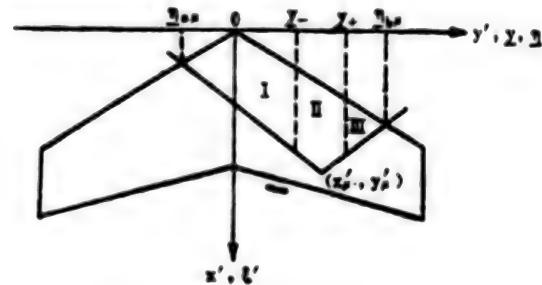
Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese Vol 4 No 3, Sep 86 pp 333-337

[English abstract of article by Lu Shuquan [4151 0647 0356] of Nanjing Aeronautical Institute]

[Text] Some improvements have been made to the spanwise integration of the supersonic kernel function method. The results of the flutter calculation of two delta wings show that the accuracies of the flutter velocity and frequency have been considerably improved when compared with those obtained using the original method.



before modification



after modification

9717

CSO: 4009/11

PHYSICAL SCIENCES

STUDY OF DEACTIVATION MECHANISM OF Fe-Sb-W OXIDE CATALYST BY ESR

Liaoning YINGYONG HUAXUE [CHINESE JOURNAL OF APPLIED CHEMISTRY] in Chinese
Vol 3 No 4, Aug 86 pp 26-29

[English abstract of article by Li Shufang [2621 3219 5364], et al., of
Changchun Institute of Applied Chemistry, Chinese Academy of Sciences]

[Text] The deactivation mechanism of Fe-Sb-W oxide catalyst for ammonoxidation of propylene has been studied by ESR. The amount of coke deposited on the surface of the catalyst and the structural changes of the catalyst were determined simultaneously. It is shown that the reaction $\text{FeSbO}_4 + e \rightarrow \alpha\text{-Fe}_2\text{O}_3 + \text{Sb}_2\text{O}_3$ took place when the amount of deposited coke exceeded a certain limit and the active structure of the surface of the catalyst deteriorated. The catalyst was then seriously deactivated, with the conversion of propylene and yield of acrylonitrile being only 40 percent and 9 percent respectively, and the main product being CO_2 . (Paper received 25 April 1985; finalized 10 September 1985.)

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CSO: 4009/1034

PHYSICAL SCIENCES

STUDIES OF EXTRACTION CHEMISTRY OF PALLADIUM. I. ON THE EXTRACTION EQUILIBRIUM OF PALLADIUM(II) WITH QUATERNARY AMMONIUM SALT N₂₆₃

Liaoning YINGYONG HUAXUE [CHINESE JOURNAL OF APPLIED CHEMISTRY] in Chinese Vol 3 No 4, Aug 86 pp 30-34

[English abstract of article by Gai Huifa [5556 2585 3127], et al., of the Department of Chemistry, Shandong University, Jinan]

[Text] The extraction of palladium(II) with the quaternary ammonium salt N₂₆₃ in n-octane from a hydrochloric acid medium has been studied at 25±1°C. The experimental results indicate that the extraction is an anion exchange process:



where AC₁ and (o) represent N₂₆₃ and the organic phase respectively. Equation (I) takes place at higher acidity, but with the lowering of the acidity equation (II) becomes predominant. The experimental results also show that the dimer species of Pd(II) is formed in the organic phase with the increasing in it of Pd(II). The influences of temperature and added (n-octanol) on the extraction of Pd(II) are also discussed. (Paper received 22 August 1985; finalized 28 December 1985.)

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CSO: 4009/1034

PHYSICAL SCIENCES

MODIFIED MATHEMATICAL MODEL OF FRACTIONAL COUNTER CURRENT EXTRACTION FOR RARE EARTH SEPARATION

Liaoning YINGYONG HUAXUE [CHINESE JOURNAL OF APPLIED CHEMISTRY] in Chinese Vol 3 No 4, Aug 86 pp 54-57

[English abstract of article by Li Han [2621 3211] and Chen Zhichuan [7115 1807 0278] of Changchun Institute of Applied Chemistry, Chinese Academy of Sciences]

[Text] The model of fractional counter current extraction (FCCE) is modified based on the study of the extraction mechanism. In this model, $2n$ equations for the equilibrium acidity ($H(I) = H_0 - nX_t(I)$) and extractant concentration ($Z(I) = Z_0 - nY_t(I)$) are substituted into the FCCE model proposed by the authors earlier (reference (1)) and the number of equations can be reduced from $2n(m+1)$ to $2nm$.

An improvement in the restriction and iteration of the solution is taken, making the physical meaning of the solution more accurate and, therefore, stability of convergence.

A mathematical simulation for HEH(EHP)-kerosene-HNO₃-(Sm-Gd)(NO₃)₃ FCCE system is given, and the calculated values are more fit with the experimental data than they were in the earlier work. The influences of the extraction conditions on the separation are also discussed. It is shown that this model can be applied to computer aided design. (Paper received 20 June 1985; finalized 19 December 1985.)

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9717
CSO: 4009/1034

PHYSICAL SCIENCES

ELECTROCATALYSIS OF METALLOPORPHYRINS. IV. ELECTROCATALYSIS OF CYSTINE REDUCTION BY HEAT-TREATED COBALT TETRA-(PARA-METHOXYPHENYL) PORPHYRINS ADSORBED ON GRAPHITE

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44 No 9, Sep 86 pp 863-869

[English abstract of article by Wang Zongli [3769 1350 4409] and Li Changming [2621 7022 2494], et al., of the Department of Chemistry, Wuhan University]

[Text] The electrocatalytic effects of heat-treated cobalt tetramethoxyphenylporphyrin (Co-TMPP) on the cathodic reduction of cystine have been investigated in 2 mol·dm⁻³ HCl solutions using cyclic voltammetry and RRDE techniques. Both disc and ring electrodes were prepared with thin layers of heat-treated Co-TMPP preadsorbed on graphite. The cyclic voltammograms for cystine reduction on Co-TMPP/graphite electrodes, when compared with those on a thin coating of graphite without Co-TMPP, show a pair of very distinct current peaks at +0.5 and -0.5 (vs. SCE). Such experimental results indicate that heat-treated Co-TMPP exhibits very significant catalytic activity for cystine reduction in 2 mol·dm⁻³ HCl solutions. Cystine reduction on Co-TMPP/graphite electrodes is an irreversible simple charge transfer reaction. The number of electrons involved in the rate-determining step is one. In a more positive potential range (-0.35 ~ -0.45 V vs. SCE) the reaction range is governed by charge transfer kinetics, while in the more negative potential range (< -0.45 V vs. SCE) it is governed by both mass transfer and charge transfer kinetics. The reaction mechanism for cystine reduction in 2 mol·dm⁻³ HCl solutions is discussed. The current efficiency has been determined on Co-TMPP/graphite and graphite electrodes. The experimental results show that the current efficiency on the Co-TMPP/graphite electrode is higher than that on the graphite electrode. The current efficiency on both of them decreased when the potential was shifted to the more negative direction. (Paper received 28 May 1985.)

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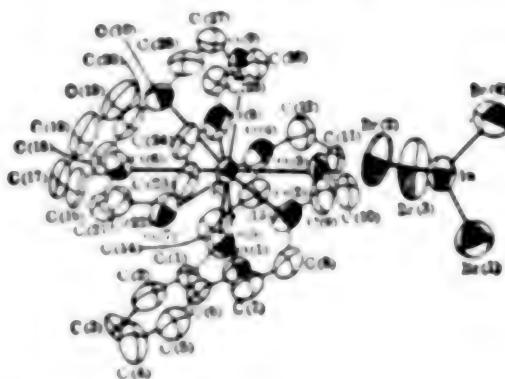
PYHICAL SCIENCES

CRYSTAL STRUCTURE OF BENZO-15-CROWN-5-POTASSIUM TETRABROMOINDATE (III)

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44 No 9, Sep 86
pp 870-874

[English abstract of article by Zhou Zhixian [0719 4460 0103], et al., of the Department of Chemistry, Zhengzhou University; Huang Jinshun [7806 6930 7311] of Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, Fuzhou]

[Text] The crystal of the title compound, $KInBr_4(C_{14}H_{20}O_5)_2$, belongs to the monoclinic system. The space group is $C_{\bar{h}}-P2_1/n$, with $a = 14.402(3) \text{ \AA}$, $b = 15.082(3) \text{ \AA}$, $c = 17.262(5) \text{ \AA}$, $\beta = 93.42(2)^\circ$ and $Z = 4$. The intensity data were collected on an Enraf-Nonius CAD4 diffractometer. Non-H atoms were located from the Patterson function and Fourier syntheses, and their parameters were refined by full-matrix least-squares methods for a final R of 0.057. X-ray structural work showed that benzo-15-crown-4(B-15-C-5) forms a 2:1 complex with $KInBr_4$, in which K^+ is coordinated by two crown rings. The anion $InBr_4^-$ has a tetrahedral configuration with the following average dimensions: $In-Br = 2.479 \text{ \AA}$, $Br-In-Br = 109.48^\circ$. It is bound with the cation complex $K(B-15-C-5)^+$ by electrostatic force to form an ion-pair. These results indicate that $In(III)$ can be quantitatively extracted into an organic phase by B-15-C-5 in the presence of excess KBr . (Paper received 3 June 1985.)



$KInBr_4(C_{14}H_{20}O_5)_2$ Molecular Structure

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PHYSICAL SCIENCES

TRANSITION METAL CARBENE COMPLEXES. IV. SYNTHESIS AND CRYSTAL STRUCTURE OF NOVEL IRON-SULFUR CLUSTER CARBENE COMPLEX OF RHENIUM- π -CYCLOPENTADIENYL (DICARBONYL){PHENYL(μ -PHENYLTHIO)-HEXACARBONYLDIIRON(μ -THIO)}CARBENE} RHENIUM

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44 No 9, Sep 86
pp 880-886

[English abstract of article by Chen Jiabi [7115 1367 4310], et al., of Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences; Zhang Zeying [1728 3419 3853], et al., of the Department of Chemistry, Beijing University]

[Text] π -Cyclopentadienyl(dicarbonyl)(phenylcarbyne)rhodium-tetrabromoborate, [π -C₅H₅(CO)₂ReCC₆H₅]BBr₄, (3), at low temperatures reacts with (μ -phenylthio) (μ -thiolato)hexacarbonyldiiron anion, (μ -C₆H₅S)(μ -LiS)Fe₂(CO)₆, (2), to give the title complex, π -C₅H₅(CO)₂ReC(C₆H₅)(μ -S)(μ -C₆H₅S)Fe₂(CO)₆, (4). This complex was identified by elemental analysis, IR, ¹H NMR and mass spectra, and finally confirmed by its single crystal X-ray structure determination. The results from spectroscopic experiments and X-ray diffraction are discussed. (Paper received 14 May 1985.)

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PHYSICAL SCIENCES

STUDIES ON POTASSIUM ION-SELECTIVE ELECTRODES WITH BIS-CROWN ETHER AS NEUTRAL CARRIER. I. RESPONSE PERFORMANCE OF POTASSIUM ELECTRODE BASED ON MANY BIS-CROWN ETHERS

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44 No 9, Sep 86 pp 887-893

[English abstract of article by Wu Guoliang [0702 0948 2733], et al., of Qinghai Institute of Salt Lakes, Chinese Academy of Sciences, Xining; Jin Daosen [6855 6670 2773], et al., of Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences]

[Text] PVC membrane K⁺-selective electrodes based on 19 bis-crown ethers as neutral carriers have been prepared and their characteristics investigated.

The response performances of 4', 4"-(*o*- or *m*-phenylenedioxymethylene) [(benzo-15-crown-5)(benzo-18-crown-6)] (7,8) and 4', 4" (*o*- or *m*-phenylenedioxy-methylene) bis (benzo-15-crown-5) (iu,ii) K⁺-selective electrodes are better than those of the others. At 25°C, in pure KCl solution, the Nernstian response of electrodes 7 and 10 is from 5×10^{-2} to 10^{-3} mol·dm⁻³; K_{θθK⁺} of these electrodes is 3×10^{-4} , and K_{K⁺C₈H₁₀} is less than 10^{-2} . The response performance of the electrodes decreased with the lowering of the temperature of the solution, with slopes of about 40 mV/pK⁺ at 0°C.

The results show that the lifetime of K⁺-selective electrodes of the bis-crown ethers with ester linkage is short and the characteristics of K⁺-selective electrodes with some bis(crown) Schiff bases or their hydrogenated products are inferior to those of 7, 8, 10 and ii. (Paper received 29 December 1984; finalized 3 March 1986.)

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PHYSICAL SCIENCES

LUMINESCENCE DECAY OF EXCITED URANYL ION IN PERCHLORIC ACID SOLUTION

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44 No 9, Sep 86
pp 900-905

[English abstract of article by Zheng Qike [6774 0120 0344], et al., of the Laser Chemistry Laboratory, Fudan University, Shanghai]

[Text] The luminescence decay and time-resolved luminescence spectra of the excited uranyl ion in perchloric acid solution have been studied with a pulsed nitrogen laser and boxcar integrated averager. The luminescence decay depends on the concentration of U(VI) and the pH of the aqueous solution. When the U(VI) concentration is less than 10^{-3} mol·dm⁻³, the luminescence decay is singly exponential from pH 1.5 to 4.0. The lifetime is about 2.5 μ s and no pH effect is observed. When the U(VI) concentration is higher than 10^{-3} mol·dm⁻³, the luminescence undergoes biexponential decay, and a longer lifetime component is found. Time-resolved spectra with delay times of 0.5 and 20 μ s reveal that the biexponential decay can be interpreted in terms of the deactivation of the excited uranyl aquo-ion and hydrolysis product of U(VI). (Paper received 7 May 1985.)

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PHYSICAL SCIENCES

STUDIES OF HYDROLYTIC POLYMERIZATION OF CHROMIUM(III) ION. IX. IN THE PRESENCE OF MALEIC ACID, COMPUTER AS REFINEMENT TO GRAPHICAL METHOD

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44 No 9, Sep 86
pp 906-913

[English abstract of article by Luo Qinhui [5012 0530 1979], et al., of the Coordination Chemistry Research Institute, Nanjing University]

[Text] The hydrolytic polymerization of Cr^{3+} in the presence of maleic acid was studied by the equilibrium pH method at 60°C and constant ionic strength, with maleic acid and Cr^{3+} both at three different concentrations: 0.006, 0.008 and $0.01 \text{ mol} \cdot \text{dm}^{-3}$. The state of Cr^{3+} in aqueous solution was determined by the graphical method and pqr analysis. The following species were found to be present: $[\text{CrA}]^+$, $[\text{Cr(OH)}\text{A}]$, $[\text{Cr}_2(\text{OH})_2\text{A}_2]$. The results obtained by the graphical method were refined by computer calculation with the data of about 50 experimental points. Hydrolysis constants of all species were obtained with good fitting. It is obvious that the results obtained by the program LEMIT are more accurate than those obtained by the graphical method. the mechanism of Cr^{3+} polymerization in the presence of maleic acid is discussed.
(Paper received 31 May 1985.)

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PHYSICAL SCIENCES

STUDIES ON SULFINATODEHALOGENATION. IX. SYNTHESIS AND REACTION OF SECONDARY PERFLUOROALKYL IODIDE¹

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44 No 9, Sep 86
pp 940-945

[English abstract of article by Huang Weiyuan [7806 4850 0997], et al., of Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences]

[Text] Several derivatives of secondary perfluoroalkyl iodides, such as $\text{CF}_3\text{CFI}(\text{CF}_2)_2\text{O}(\text{CF}_2)_2\text{SO}_2\text{F}$ (3), $\text{CF}_3\text{CFI}(\text{CF}_2)_2\text{O}(\text{CF}_2)_2\text{SO}_3\text{Na}$ (4), $\text{CF}_3\text{CFI}(\text{CF}_2)_n\text{Cl}$ (7a, n=2; 7b, n=4) and $\text{CF}_3(\text{CF}_2)_2\text{OCFJCF}_3$ (8), were synthesized using known methods, their reactions with sodium dithionite were studied and various olefins were added to the reaction system as radical traps to yield the 1:1 radical adducts. (Paper received 13 May 1985.)

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PHYSICAL SCIENCES

STUDIES OF COATED CARBON ROD ION-SELECTIVE ELECTRODES. II. 13,14-BENZO-1,4,8,11-TETRATHIA(15-CROWN-4)--PVC MEMBRANE SILVER ELECTRODE

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44 No 9, Sep 86
pp 951-954

[English abstract of article by Xi Zhiwen [1153 3112 2429], et al., of the Department of Chemistry, Sichuan University, Chengdu; Yang Jiqiu [2799 1323 4428], et al., of Chengdu Institute of Organic Chemistry, Chinese Academy of Sciences]

[Text] A new silver ion-selective electrode fabricated by coating a graphite rod with PVC membrane containing 13,14-benzo-1,4,8,11-tetrathia(15-crown-4) (TTX) as the neutral carrier is described. This electrode exhibits a linear response to the silver ions within the concentration range of $5 \times 10^{-6} \sim 1 \times 10^{-1} \text{ mol} \cdot \text{dm}^{-3}$ with a slope of 65 mV at pH 1.0 to 5.5. The detection limit is $1 \times 10^{-6} \text{ mol} \cdot \text{dm}^{-3}$. The selectivity of Ag^+ relative to Hg^{2+} , Cu^{2+} , Pb^{2+} , Cd^{2+} and Zn^{2+} are 8×10^{-2} , 5×10^{-3} , 1×10^{-4} , 5×10^{-4} and 1×10^{-5} respectively, and the membrane resistance is lower than $1 \text{ M}\Omega$. The principal behavior is the same as that of the commercial silver electrode. (Paper received 17 January 1985; finalized 2 January 1986.)

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PHYSICAL SCIENCES

GENERAL METHOD FOR INDEXING X-RAY POWDER DIFFRACTION PATTERNS AND FOR LATTICE CONSTANTS CALCULATION

Beijing GUISUANYAN XUEBAO [JOURNAL OF CHINESE SILICATE SOCIETY] in Chinese
Vol 14 No 2, Jun 86 pp 129-139

[English abstract of article by Guo Changlin [6753 1603 7207], et al., of Shanghai Institute of Ceramics, Chinese Academy of Sciences]

[Text] In this paper, a general calculating method for indexing the X-ray powder diffraction patterns of any compound of an unknown system and for calculating lattice constants is presented using all available diffraction data. The first indexing procedure is to index the pattern on the basis of cubic and hexagonal systems by using a special trial and error indexing subroutine. If this fails, the zone-indexing method may then be applied. By doing so, a mistake in judgment in Visser's indexing program for cubic and hexagonal systems can be avoided naturally. Calculations of a number of powder diffraction data for various compounds of different systems have proved the applicability of this method to any compound of an unknown system, and the final results of the crystal system, lattice constants and indexing will be obtained directly at the same time. (Paper received 21 May 1984.)

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PHYSICAL SCIENCES

PRELIMINARY STUDY OF TOUGHENING EFFECT OF ZrO₂ ON PRESSURELESS SINTERED Si₃N₄

Beijing GUISUANYAN XUEBAO [JOURNAL OF CHINESE SILICATE SOCIETY] in Chinese
Vol 14 No 2, Jun 86 pp 153-163

[English abstract of article by Sheng Xumin [4141 4872 2404], et al., of
Nanjing Institute of Chemical Technology]

[Text] A preliminary study of the toughening effect of ZrO₂ on pressureless sintered Si₃N₄ has been made. If 8 wt percent ZrO₂ is added to Si₃N₄ containing MgAl₂O₄ or Y₂O₃-Al₂O₃ as the sintering aid, fracture toughness will increase by 30 percent and 15 percent respectively, up to 6.43 and 7.14 MPa·m^{1/2}, and bending strength at room temperature will be about 500-600 MPa, even exceeding 700 MPa individually.

Measures taken in order to inhibit the formation of ZrN are discussed. It is found that the amount and existing form of Al₂O₃ added to Si₃N₄ as a part of the sintering aid affect the formation of ZrN obviously. Adopting a protective powder containing SiO₂, proper sintering temperature and soaking time, and controlling the particle size of the ZrO₂ powder would minimize the formation amount of ZrN. Based on the results of X-ray diffraction phase analysis and composition analysis of Zr by electronic probe, the toughening mechanisms of two groups of samples with different compositions have been explored. It is believed that the toughening effect can be further enhanced by using ZrO₂ powder with a narrow range of particle size distribution, less aggregation and uniform dispersion, etc., thus obtaining an ideal microstructure. (Paper received 28 January 1985; finalized 20 December 1985.)

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PHYSICAL SCIENCES

PROPERTIES AND CRYSTAL STRUCTURE OF COMPOUND $\text{Ca}_{10}\text{Si}_6\text{O}_{21}\text{Cl}_2$ IN THREE COMPONENT SYSTEM $\text{CaO}-\text{SiO}_2-\text{CaCl}_2$

Beijing GUISUYAN XUEBAO [JOURNAL OF CHINESE SILICATE SOCIETY] in Chinese
Vol 14 No 2, Jun 86 pp 183-190

[English abstract of article by Ye Ruilun [0673 3843 0243], et al., of Wuhan University of Technology; Zhang Zeying [1728 3419 3853] of Beijing University]

[Text] The synthetic compound $\text{Ca}_{10}\text{Si}_6\text{O}_{21}\text{Cl}_2$ is a colorless, transparent, prismatic crystal, forming C_3S_2 and $\beta\text{-C}_2\text{S}$ when reacting with water vapor at about 1100°C . It is a kind of nesosilicate mineral with the isolated group of $[\text{Si}_2\text{O}_7]$ as its basic skeleton. The crystal system of the compound was incorrectly considered as orthorhombic, based on its unit cell parameters in reference [4], because the author of the reference neglected the weak diffraction layer in the oscillating photo along the \bar{a} axis. The actual crystal system should be monoclinic with unit cell parameters $a = 7.5166(12)\text{\AA}$, $b = 17.3311(21)\text{\AA}$, $c = 8.6754(12)\text{\AA}$, $\beta = 102.513^\circ$ and space group $p2_1/a$. The direct method in the SHELXTL program was used to obtain the contour of the structure. Modified by the least-square method, four circles for the coordinates and enantiomorphic thermal factors, the discrepancy factors became $R = 0.0716$, $R_w = 0.0631$. The crystal is of an ordered structure in the short range and of a disordered structure in the long range. The symmetry based on the average structure is $P2_1/a$ and that of the ordered domain is $P2_1$. (Paper received 25 March 1985.)

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PHYSICAL SCIENCES

EXAFS STUDY OF STRUCTURE OF BISMUTH GERMANATE GLASSES IN VICINITY OF Ge ATOMS

Beijing GUISUANYAN XUEBAO [JOURNAL OF CHINESE SILICATE SOCIETY] in Chinese
Vol 14 No 2, Jun 86 pp 198-205

[English abstract of article by Lin Yunfei [2651 0061 7378], et al., of
Wuhan University of Technology; Lu Kunquan [7120 0981 2938], et al., of
the Institute of Physics, Chinese Academy of Sciences]

[Text] EXAFS spectra of glasses in the $\text{GeO}_2\text{-Bi}_2\text{O}_3$ system were measured, and
the bond length of Ge-O and Ge-Ge and corresponding coordination numbers
have been determined using GeO_2 (α -quartz) crystal as a standard sample.
The results indicate that the Ge atom in bismuth germanate glasses exists
in the form of $[\text{GeO}_4]$, and Bi_2O_3 appears to have a depolymerization effect
on the Ge-O-Ge network. (Paper received March 1985; finalized January 1986.)

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PHYSICAL SCIENCES

GROWTH AND STRUCTURE OF $\text{KLnP}_4\text{O}_{12}$ CRYSTALS

Beijing GUISUANYAN XUEBAO [JOURNAL OF CHINESE SILICATE SOCIETY] in Chinese
Vol 14 No 2, Jun 86 pp 212-218

[English abstract of article by Hong Guangyan [3163 1639 6056], et al., of
Changchun Institute of Applied Chemistry, Chinese Academy of Sciences]

[Text] A series of $\text{KLnP}_4\text{O}_{12}$ crystals ($\text{Ln} = \text{La}, \text{Ce}, \text{Pr}, \text{Nd}, \text{Sm}, \text{Eu}, \text{Gd}, \text{Tb}, \text{Dy}, \text{Ho}, \text{Er}, \text{Tm}$ and Y) were grown by the evaporation method from phosphoric acid solution. The growth conditions were studied and some fairly good crystals were obtained. The composition was determined by chemical analysis and the results show that the grown crystals are of $\text{KLnP}_4\text{O}_{12}$. X-ray diffraction patterns of the grown crystals were taken and some crystallographic parameters of $\text{KLnP}_4\text{O}_{12}$ were calculated. It can be seen from these parameters that there exist two types of structures in $\text{KLnP}_4\text{O}_{12}$, i.e., α - and β -type. The cell volumes and the average distances of the $\text{Ln}-\text{O}$ bond decrease as the atomic numbers increase and the radii of Ln^{3+} decrease. The infrared spectra of $\text{KLnP}_4\text{O}_{12}$ show that characterizing P-O bonds may also be classified into two types corresponding to the two types of crystal structure. Accordingly, the type of structure of $\text{KLnP}_4\text{O}_{12}$ can be determined with the aid of their infrared spectra. (Paper received 25 January 1985.)

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PHYSICAL SCIENCES

SOLUTION KINETICS OF NEODYMIUM ALUMINUM BORATE AND ITS STEADY-STATE GROWTH RATE IN $K_2Mo_3O_{10}$ - B_2O_3 FLUX

Beijing GUISUANYAN XUEBAO [JOURNAL OF CHINESE SILICATE SOCIETY] in Chinese
Vol 14 No 2, Jun 86 pp 219-225

[English abstract of article by Chen Changkang [7115 7022 1660], et al., of Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences]

[Text] In this paper the conditions of synthesis for the flux $K_2Mo_3O_{10}$ used in the growth of laser crystal $NdAl_3(BO_3)_4$ (NAB) have been investigated by differential thermal analysis (DTA), thermogravimetry (TG) as well as X-ray diffraction. The partial phase diagram in the vicinity of $K_2Mo_3O_{10}$ in the system K_2O - MoO_3 has also been determined. By measuring the seed solution curve, we have not only determined the NAB saturation temperature in the flux system $K_2Mo_3O_{10}$ - B_2O_3 , but also analyzed the solution-diffusion kinetics under steady state conditions. The results obtained agree with the experimental data fairly well. In addition, the activation energy and diffusion rate parameters have also been obtained. The solute diffusion in the high temperature solution controls the crystal growth. The steady-state growth rate (10^{-1} mm/d) in molten salt under unstirring conditions is evaluated. Finally, the difficulties in growing NAB crystals and possible improvement in technology of growing this crystal are discussed. (Paper received 24 February 1985.)

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PHYSICAL SCIENCES

STUDY OF RELATIONSHIP BETWEEN CHARACTERISTIC TEMPERATURE AND COMPOSITION OF OXYFLUORIDE GLASSES

Beijing CUISUANYAN XUEBAO [JOURNAL OF CHINESE SILICATE SOCIETY] in Chinese
Vol 14 No 2, Jun 86 pp 241-246

[English abstract of article by Zhang Lipeng [1728 4539 7720], et al., of
the Department of Chemistry, Wuhan University]

[Text] The relationship between the characteristic temperature and the composition of oxyfluoride glasses in $\text{AlF}_3\text{-PbF}_2\text{-P}_2\text{O}_5$ and $\text{AlF}_3\text{-PbF}_2\text{-SiO}_2$ systems has been studied. Based on the results, the function of each component in the composition of the glass is discussed briefly. (Paper received 30 January 1985.)

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CSO: 4009/1026

PHYSICAL SCIENCES

PROPERTIES OF COLLIDING PULSE MODE-LOCKING IN CONSIDERATION OF COHERENT
INTERACTION

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6 No 9, Sep 86
pp 781-788

[English abstract of article by Wang Zhijiang [3769 0037 3068], et al., of
Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Text] The authors have calculated the properties of colliding pulse mode-locking by considering coherent interactions. The results are remarkably different from those calculated from rate equations, and they are in qualitative agreement with experimental data, especially with regard to pulse shapes.

CSO: 4009/9

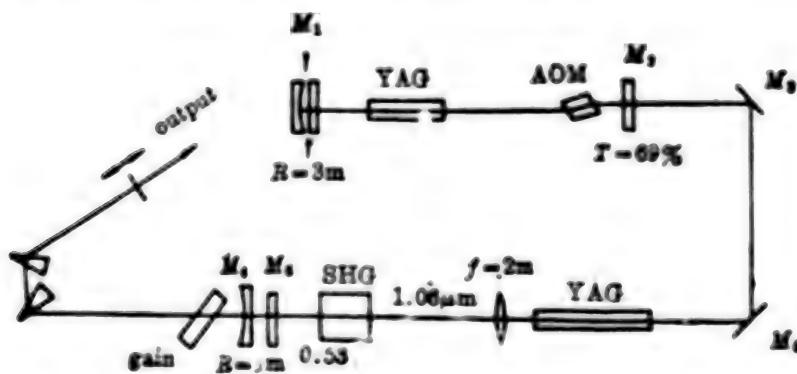
MODEL ANALYSIS AND EXPERIMENTAL STUDY OF SYNCHRONOUSLY PUMPED TRANSIENT MODE-LOCKED RHODAMINE DYE LASER

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6 No 9, Sep 86 pp 789-795

[English abstract of article by Chen Shaohuo [7115 4801 0735], et al., of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Text] The evolution of light pulses from a synchronously pumped transient mode-locked rhodamine dye laser has been calculated by using the rate equation method. The transient characteristics of the system with only a 12-round-trip modulation are analyzed. The real time observed with a streak camera with 1.25 (ps/channel) is in qualitative agreement with the computed results.

The effects of the pump power on the laser pulse width are calculated. The authors have found that the laser pulses first become shorter, then become longer, and finally tend toward a dynamic equilibrium. The gain modulation plays a role only in the former part of the laser pulse round trips; the laser pulse width becomes longer as the pump increases.



Schematic diagram of the experimental arrangement M_1 , M_2 : dichroic mirror

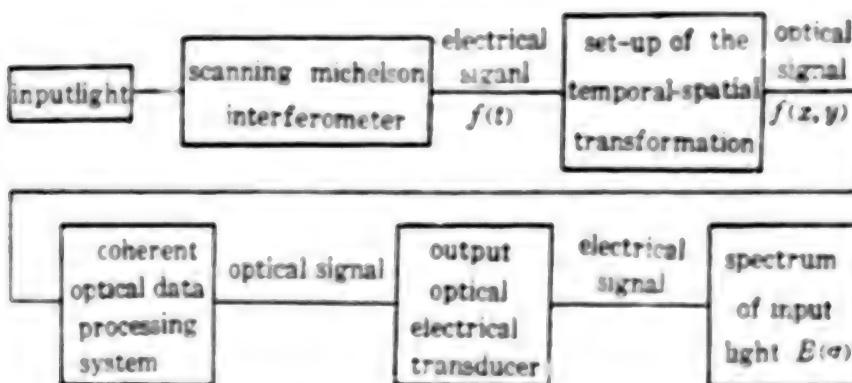
PHYSICAL SCIENCES

OPTICAL DATA PROCESSED FOURIER TRANSFORM SPECTROMETER

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6 No 9, Sep 86
pp 801-806

[English abstract of article by Mu Guoguang [3018 0948 0342], et al., of the Institute of Modern Optics, Nankai University, Tianjin; and Liu Huaguang [0491 5478 0342] of the University of Alabama, U.S.A.]

[Text] In this paper the authors present a new technique for accomplishing the Fourier transformation of interferograms via total optical means. The technique involves: (1) Obtaining interferograms of input optical signals through scanning by a Michelson interferometer. (2) Accomplishing the time-to-space coordinate transformation of the interferograms by linearly recording on the proper medium through a temporal-spatial transducer (KDP). (3) Completing the Fourier transformation of the spatial interferogram by using a coherent optical spectrum analyzing system and then obtaining the spectrum of the input optical signal at the output plane of the system.



A block diagram of new Fourier transform spectrometer

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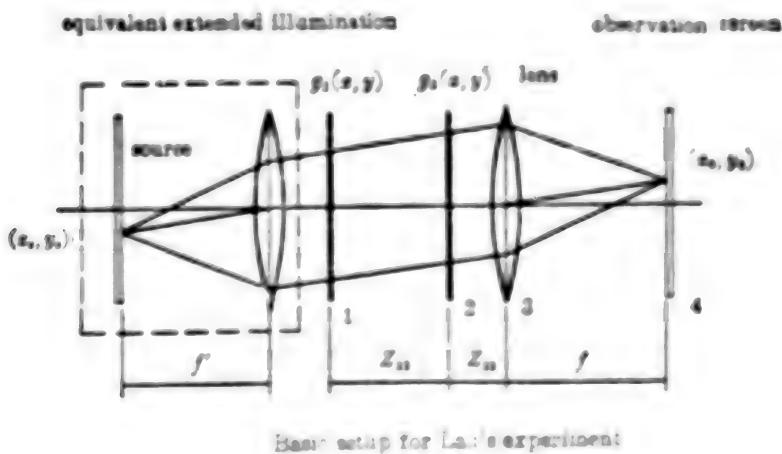
PHYSICAL SCIENCES

THEORY FOR LAU EFFECT OF PLANE OBJECTS

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6 No 9, Sep 86
pp 807-814

[English abstract of article by Liu Liren [0491 4539 0086] of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Text] A new idea is proposed to extend the Lau effect to any type of plane object, which is explained by an off-axis optical Fourier transformation system model. Two necessary conditions are deduced. First, there must exist a definite correlation pattern between the intensity transmittances of two plane objects; second, the plane objects can be self-imaged by diffraction in a plane monochromatic wave of normal incidence. The Lau effect of two gratings is also discussed completely from the new viewpoint in which Fresnel's effect is extended. In this case it is easy to predict the profiles of Lau fringes from the correlation operation.



Basic setup for Lau's experiment

CSO: 4009/9

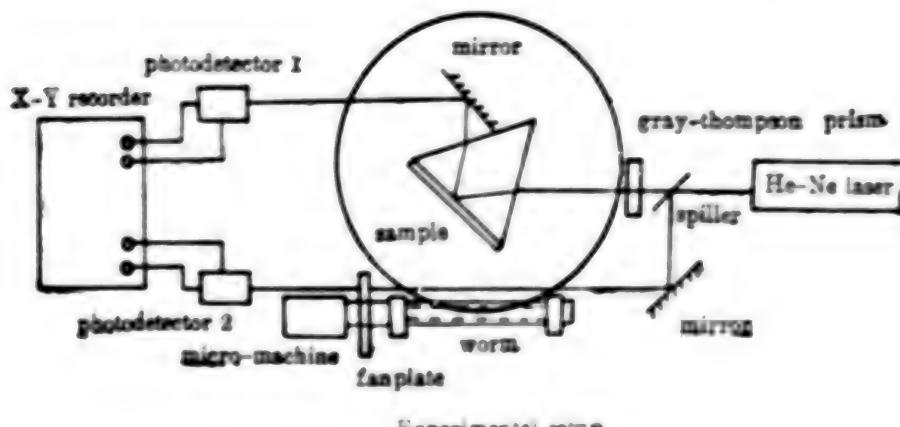
PHYSICAL SCIENCES

LONG-RANGE SURFACE MODES OF METAL-CLAD FOUR-LAYER WAVEGUIDES

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6 No 9, Sep 86
pp 815-823

[English abstract of article by Yang Fuzi [2799 0265 0037], et al., of the Department of Applied Physics, Shanghai Jiaotong University]

[Text] The surface modes of metal-clad four-layer waveguides were analyzed theoretically. The authors found that the long-range surface modes could be excited in such waveguides. The long-range surface modes were studied experimentally by using the angle-scanning-attenuated total-reflection method; the dependence of wave vector mode losses on waveguide parameters was measured. The experimental results were in good agreement with theoretical calculations.



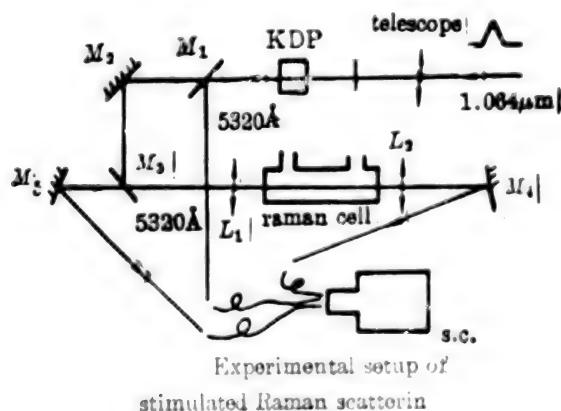
CSD: 4009/9

TEMPORAL BEHAVIOR OF STIMULATED RAMAN SCATTERING EXCITED BY AMPLITUDE MODULATING PUMP LIGHT

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6 No 9, Sep 86
pp 824-827

[English abstract of article by Meng Shaonian [1322 4801 6343], et al., of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Text] The authors investigated experimentally the temporal behavior of the forward and backward Stokes pulses from stimulated Raman scattering in ethanol pumped by a subnanosecond 5321 Å pulse with amplitude modulation. It was found that both the forward and backward Stokes pulses had the same modulation period as the pump beam, but the modularity of the Stokes pulse was much larger. A theoretical explanation for the experimental results is presented.



CSO: 4009/9

PHYSICAL SCIENCES

NEW X-RAY ANALYZER CRYSTAL--TRIHYDROXYMETHYLAMINOMETHANE

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6 No 9, Sep 86
pp 848-853

[English abstract of article by Su Genbo [5685 2704 0590], et al., of Fujian Institute of Research on Matter Structure, Chinese Academy of Sciences, Fuzhou]

[Text] According to the relationship between crystal structure and X-ray diffraction properties, a new analyzer crystal--trihydroxymethylaminomethane (TAM)--has been prepared. It was found to have stable physico-chemical properties, with characteristics such as mechanical performance, linear expansion coefficient and X-ray diffraction properties better than those of pentaerythritol (PET), the crystal commonly used today. It has also been found that the TAM crystal is useful in practical applications.



The crystal of TAM

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CSO: 4009/9

APPLIED SCIENCES

RESIDENCE TIME PROFILE AND PLATE EFFICIENCY FOR LARGE TRAY WITH SINGLE-PASS OR TWO-PASS LIQUID FLOW

Beijing HUAGONG XUEBAO [JOURNAL OF CHEMICAL INDUSTRY AND ENGINEERING (CHINA)]
in Chinese No 2, Jun 86 pp 151-161

[Text] This paper presents the residence time profiles for single-pass and two-pass liquid flows by a tracer technique for a water/air system in an experimental semicircular sieve tray of 2 meters in diameter. Analysis of residence time profiles indicates a complicated flow pattern for the single-pass flow. For the two-pass liquid, a similar flow pattern is observed from the residence profiles on the center downcomer tray, while relatively uniform convergent flow is found on the side downcomer tray.

A mathematical model based on residence time profiles for the single-pass tray is presented to compute the concentration profiles and enhancement ratio, i.e., the ratio of the Murphree tray efficiency to the point efficiency. The average deviation between the predicted and experimental tray efficiency found in the literature is less in the present model than in other existing models. Similar modeling for two-pass liquid flow is also presented, including the central downcomer and side downcomer tray, and the proposed model agrees closely with recently published results.

Finally, this paper introduces two kinds of new constructions of the experimental tray, which show successful improvement of the uniformity of liquid flow. These constructions are simple, practical and capable of increasing tray efficiency considerably. (Paper received 21 November 1984; finalized 4 February 1985.)

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CSO: 4009/1031

APPLIED SCIENCES

EXERGY ANALYSIS OF DISTILLATION STAGES BY NON-EQUILIBRIUM THERMODYNAMICS

Beijing HUAGONG XUEBAO [JOURNAL OF CHEMICAL INDUSTRY AND ENGINEERING (CHINA)]
in Chinese No 2, Jun 86 pp 162-171

[English abstract of article by Sun Zhifa [1327 1807 4099], et al., of
Beijing Institute of Chemical Technology]

[Text] An exergy balance equation which relates to heat and mass transfer on distillation stages has been derived from the theory of non-equilibrium thermodynamics. This equation was used to analyze an ethylene distillation tower, and the results compared satisfactorily with those of the equilibrium thermodynamic exergy analysis.

In a multiphase discontinuous system, each phase may be considered as a subsystem and all subsystems are separated by interfaces. With appropriate hypotheses, the equation of exergy loss relating to energy and mass transfer through interfaces may be expressed as follows:

$$D = T_c \left[J_c \cdot \Delta \left(\frac{1}{T} \right) - \sum_i J_i \cdot \Delta \left(\frac{P_i}{T} \right) \right]$$

Thus, a profound insight into the distillation process can be gained in order to provide ideas for further improvement of the distillation scheme. (Paper received 26 January 1985; finalized 26 July 1985.)

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CSO: 4009/1031

APPLIED SCIENCES

PREDICTION OF BREAKTHROUGH CURVES FOR FIXED BEDS

Beijing HUAGONG XUEBAO [JOURNAL OF CHEMICAL INDUSTRY AND ENGINEERING (CHINA)]
in Chinese No 2, Jun 86 pp 183-192

[English abstract of article by Wang Changtai [3769 7022 3141] and Lin Cheng
[2651 6134] of the Department of Chemical Engineering, Fuzhou University]

[Text] A simple, easy-to-use approximate equation, in the form of a normal probability distribution function, has been derived for breakthrough curves of fixed-bed reactors or adsorbers. The equation predicts breakthrough curves and evolution of concentration or temperature distribution in fixed beds, with an accuracy higher than, or comparable to, other equations previously proposed. (Paper received 26 June 1984; finalized 20 March 1985.)

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CSO: 4009/1031

APPLIED SCIENCES

SYNTHESIS OF ENERGY INTEGRATED DISTILLATION TRAINS

Beijing HUAGONG XUEBAO [JOURNAL OF CHEMICAL INDUSTRY AND ENGINEERING (CHINA)]
in Chinese No 2, Jun 86 pp 193-203

[English abstract of article by Zhou Li [0719 3810], et al., of the Chemical Engineering Research Center, Tianjin University]

[Text] The energy integrated distillation train is synthesized in two levels: maximizing the net benefits of heat integration over both design variables of the simple columns and heat-matches among them, and then minimizing the total costs of the train over all separation sequences by means of integration trees. It does not involve much computation because the feasible heat matches are few and a simplified technique to determine the optimal distillation pressure is employed. The synthesis procedure is illustrated by a popular example, and comparison of the synthesis results of different methods shows that the new strategy can achieve more savings in both energy and separation costs.
(Paper received 23 November 1984; finalized 24 January 1986.)

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CSO: 4009/1031

APPLIED SCIENCES

HEAT TRANSFER AND PRESSURE DROP CALCULATION FOR CYLINDRICAL PIPE FURNACES PROCESSING CRUDE OIL

Beijing HUAGONG XUEBAO [JOURNAL OF CHEMICAL INDUSTRY AND ENGINEERING (CHINA)]
in Chinese No 2, Jun 86 pp 204-211

[English abstract of article by Huang Zuqi [7806 4371 4388], et al., of East China Petroleum Institute]

[Text] Heat transfer in the radiation chamber of a cylindrical tubular heater is analyzed. An energy conservation model using cylindrical coordinates in the form of integral and differential equations is used for describing the radiative and convective heat transfer in a combustion chamber. The Monte Carlo method and the difference method are used for solving the energy equation. For calculation inside the tubes, crude oil is treated as a mixture of many pseudo-pure components, and the Soave equation is used for the calculation of vapor-liquid equilibrium and the physical and thermodynamic properties of the liquid and vapor phases. Heat transfer and pressure drop of the fluid flow inside the pipe are estimated next.

Results calculated by using a PDP-11/45 computer are compared with the operating data of the crude heater in a refinery. It is believed that the model developed and the calculation program are acceptable. (Paper received 27 July 1984; finalized 6 October 1984.)

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APPLIED SCIENCES

EFFECT OF VAPOR MIXING ON TRAY EFFICIENCY

Beijing HUAGONG XUEBAO [JOURNAL OF CHEMICAL INDUSTRY AND ENGINEERING (CHINA)]
in Chinese No 2, Jun 86 pp 220-227

[English abstract of article by Lu Xiulin [6424 4423 2651], et al., of the
Department of Chemical Engineering, East China Institute of Chemical Technology]

[Text] A new mixing model is presented for taking into account the effect of vapor mixing on tray efficiency under the condition of partial mixing of the liquid, and mathematical correlations are obtained to predict the tray efficiency of the distillation column. The calculated results are in good agreement with those reported by Ashley and Haselden and those of Hirotake Katayama, et al. The mathematical correlations proposed in this paper are simpler and more convenient to use. For limited cases, the present mathematical model can be simplified to equations identical to those published in the literature. (Paper received 9 October 1983; finalized 5 August 1985.)

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CSO: 4009/1031

APPLIED SCIENCES

PERTURBED-HARD-CHAIN EQUATION OF STATE FOR VAPOR-LIQUID EQUILIBRIA FOR SYSTEMS CONTAINING POLAR SOLVENTS

Beijing HUAGONG XUEBAO [JOURNAL OF CHEMICAL INDUSTRY AND ENGINEERING (CHINA)]
in Chinese No 2, Jun 86 pp 238-247

[English abstract of article by Pan Shaqing [3382 3097 7230], et al., of Beijing Institute of Chemical Technology]

[Text] The present paper explores the applicability of the perturbed-hard-chain equation of state for estimating vapor-liquid equilibria for solutions of CO₂, CO, CH₄, H₂, N₂ and Ar in polar solvents such as H₂O and CH₃OH. Related parameters thus calculated, from literature data, indicate that for mixtures consisting of polar compounds alone or of polar and nonpolar compounds, the adjustable parameters are all temperature-related and should be computed from the polynomial equation:

$$\beta = \alpha_0 + \alpha_1 T + \alpha_2 T^2$$

A computer program has been formulated for the eight-component system, CH₃OH-H₂O-CO₂-CO-H₂-CH₄-N₂-Ar. The resulting simulation for the vapor-liquid separation in methanol production is compared closely with the flowsheet data of Lurgi, Speichim and Billingham. (Paper received 18 April 1983; finalized 3 November 1983.)

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APPLIED SCIENCES

CONTINUOUS LOGIC (CL) AS NEW TOOL IN ELECTRONIC CIRCUITS AND SYSTEMS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 5, Sep 86 pp 1-11

[English abstract of article by Wang Shoujue [3769 1343 6030] of the Institute of Semiconductors, Chinese Academy of Sciences]

[Text] The characteristics of continuous logic (CL) and its applications are studied. The results show that the conventional architecture of systems, with A/D and D/A converters to link the analog parts with the digital parts, may be changes by using CL. Then, the direct ultra high speed "digital processing" of the analog signals can be realized.

The applications as the spread or compression of the time axis of the analog signals, the digitally controlled analog signal delay circuits, the real-time voting circuits for analog signals, realization of the arbitrary function $S=F(X,Y,Z,\dots)$ of the analog signals X, Y, Z, \dots , and the exchanges between time, space and amplitude axes, etc., are described.

The real ICs of continuous logic applying to the high-speed real-time Fourier transformation are introduced. The results of the primary experimental set come up to 16 MHz sampling frequency, and 2 μ s transform period for 32 points, with simple circuits and a potential for much higher speed. (Paper received December 1985; finalized March 1986.)

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CSO: 4009/1032

APPLIED SCIENCES

RELIABILITY DESIGN CONCERNING FAULT EFFECTS REDUCTION ON RADAR SYSTEM

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 5, Sep 86 pp 21-26

[English abstract of article by Ding Dinghao [0002 1353 3185] of Nanjing Electronic Technology Institute, Jiangsu]

[Text] The redundant design of system reliability is a powerful artifice in increasing the system reliability, but it will also increase the volume, weight and cost of the system. The fault effects reduction method can be used to solve this problem. Three criteria related to the possibility of the effects reduction design are presented. Some practical examples are given, and a general mathematical model of system reliability concerning fault effects reduction is derived. (Paper received February 1985; finalized July 1985.)

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APPLIED SCIENCES

INVESTIGATION OF MULTI-ALKALI PHOTOCATHODE

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 5, Sep 86 pp 27-31

[English abstract of article by Gao Lushan [7559 7627 1472] of Beijing Institute of Technology; Li Chaomu [2621 2600 2606] of PO Box 271, Nanjing]

[Text] The multi-alkali photocathode (Rb, Cs) Na₂KSb films are studied. The photocathode manufactured by means of a new technology has many advantages over the trialkali photocathode, such as higher photosensitivity, better reproducibility, less thermal emission and, in particular, much improved response to light in the green-red-infrared portion of the spectrum. The photoelectron-emissive mechanism of the photocathode films is discussed and a new structural model of energy bands at the surface of the (Rb, Cs) Na₂KSb is proposed. The use of the model to explain the results of the experiment is satisfactory. (Paper received April 1985; finalized August 1985.)

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CSO: 4009/1032

APPLIED SCIENCES

ERROR CORRECTION FOR MULTIVALUED LOGIC USING LINEAR BLOCK CODES

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 5,
Sep 86 pp 31-36

[English abstract of article by Gu Qiuxin (7357 4428 1800) of Harbin Institute
of Technology]

[Text] The characteristics and generation of the linear block codes for
error correction of multivalued logic are discussed. A system of circuit
realization for the error correction is introduced. A new type of gate DYL,
a linear AND-CR gate, is adopted in the realization of the error correction
system. The discussion centers on ternary and quaternary logic. (Paper
received December 1984; finalized December 1985.)

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PLIED SCIENCES

CAD OF BROAD-BAND GaAs FET AMPLIFIERS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 5, Sep 86 pp 43-48

[English abstract of article by Li Haomo [2621 3185 2875] of Hebei Semiconductor Research Institute, Shijiazhuang; Shi Yenyang [2457 7159 2543] of the Institute of Electronics, Chinese Academy of Sciences, Beijing]

[Text] A CAD procedure applicable to broad-band GaAs FET amplifiers is presented. The design and measurement results of two types of broad-band GaAs FET amplifiers are given. For 4-8 GHz amplifiers, the power gain $G_p = 33\text{dB} \pm 1.5\text{dB}$, and the noise figure $F_n \leq 3.7\text{dB}$. For 8-12 GHz amplifiers, $G_p = 30\text{db} \pm 1.5\text{dB}$, and $F_n \leq 6\text{dB}$. (Paper received March 1985; finalized August 1985.)

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CSO: 4009/1032

APPLIED SCIENCES

ANALYSIS AND SUPPRESSION OF INTERFERENCE MODES IN COAXIAL MAGNETRONS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 5, Sep 86 pp 56-62

[English abstract of article by Qian Weizhong [6929 1983 1356] and Zhang Feng [1728 0023] of Xi'an Jiaotong University]

[Text] This paper describes how to suppress interference modes in coaxial magnetrons and how to choose a suitable inner cavity resonant frequency. A new method of suppression of interference modes is suggested. In order to separate the high and low branches of resonant frequencies of different modes in the inner cavity, a "rising sun" cavity structure is used. The cold properties of the inner cavity are analyzed, measured and compared with those in a common coaxial magnetron. A computer-aided design method for the cavity is also given. (Paper received February 1985; finalized September 1985.)

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CSO: 4009/1032

APPLIED SCIENCES

VIRTUAL DIAGNOSIS MODEL FOR COMPUTER SYSTEMS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 5, Sep 86 pp 69-74

[English abstract of article by Huang Kaiyuan [7806 7030 3293] of Chongqing University]

[Text] A virtual diagnosis model for computer systems is proposed wherein a subsystem is considered to be a union of a task processor and a communication processor. The idea of performing virtual tests and virtual diagnosis is presented, followed by the criteria for diagnosability, both for centralized and distributed control. An optimal design for diagnosable systems is also presented. The results obtained show clearly that the virtual diagnosis can identify more faults than t-fault diagnosis under the same structural constraints. (Paper received July 1984; finalized February 1986.)

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APPLIED SCIENCES

SPOTTING IC PHOTOMASK DEFECTS BY USING WHITE LIGHT SPATIAL FILTER PROCESSOR

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 5, Sep 86 pp 75-79

[English abstract of article by Cen Zhaochang [1478 6856 1603], et al., of South China Normal University; Li Shaoquan [2621 4801 3123], et al., of Guangzhou University]

[Text] A real-time one-lens white light information processing system is described in which spatial filtering is used to spot defects on IC photomasks. The check-up with this system is simpler, faster and more convenient than with the traditional microscopy or laser coherent optical processing technique. With the aid of this system, such defects as black spots, pinholes, scratches, loss of circuits, short-circuits or disconnections, etc., can easily be located, and defects as small as a minimum of 2 μm linearity can also be detected. (Paper received December 1984; finalized December 1985.)

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APPLIED SCIENCES

NOVEL OPTIMIZATION ALGORITHM

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 5,
Sep 86 pp 91-96

[English abstract of article by Tan Genlin [6151 2704 2651], et al., of
Beijing Polytechnic University]

[Text] A new optimization algorithm is presented. This algorithm, usin a high-order approximation for the objective function, requires neither a derivative calculation nor a linear search, and has a high convergent rate. It has been incorporated into ADIC-2, an analysis and design program for general purpose circuits. Its high efficiency is illustrated by some numerical and circuit design examples. (Paper received March 1984; finalized May 1985.)

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CSO: 4009/1032

APPLIED SCIENCES

RHEOLOGICAL CHARACTERISTICS OF TUNNEL OPENING IN MULTI-LAMINATE JOINT ROCK MASS AND ITS VISCOS ELASTO-PLASTIC EFFECTS

Shanghai TONGJI DAXUE XUEBAO [JOURNAL OF TONGJI UNIVERSITY] in Chinese Vol 14 No 3, Sep 86 pp 281-291

[English abstract of article by Li Yongsheng [2621 3057 4141], et al., of the Department of Geotechnical Engineering]

[Text] Based on creep tests of the joint surface as well as intact rock, the shear deformation rule, anisotropic rheological behavior and time dependent effect of a multi-laminate rock mass are discussed. The validity of the elastic viscoplastic mechanical model to describe the joint behavior is proved by laboratory tests. The paper derives in detail the viscoplastic strain velocities of the joint and intact rock, as well as the multi-laminate rock mass corresponding to different stress states, and presents a viscous elasto-plastic FEM taking into consideration the stepwise excavation sequence and different supporting times of the lining in underground works with large cross-sections. Through quantitative analysis and evaluation of a tunnel opening in the multi-laminate rock mass, rational proposals for the excavation and construction of underground structures are suggested. The computation shows that the present work is of valuable technical significance and economic benefit in engineering practice. (Paper received 8 August 1985.)

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APPLIED SCIENCES

APPLICATION OF POINT MATRIX IN MYKLESTED'S METHOD FOR SOLUTION OF SPECIAL VIBRATION PROBLEMS

Shanghai TONGJI DAXUE XUEBAO [JOURNAL OF TONGJI UNIVERSITY] in Chinese Vol 14 No 3, Sep 86 pp 349-358

[English abstract of article by Su Jianshou [5685 4608 1108] of the Department of Mechanical Engineering]

[Text] Myklested's Method, or the Transfer Matrix Method, is generally an effective process for the solution of flexural vibration problems in simple shaft transmission systems where an equivalent system of beams with discrete masses may be assumed. However, when special structures, such as non-elastic supports or universal joints, are constructed in the middle portion of the shaft system, an abrupt change of the shearing force or cross-sectional angular displacement at these specific points will take place. As a result, the continuity of the state vector transfer will break up and subsequent difficulties will thus inevitable arise from finding the global transfer matrix and the frequency equation. Under such circumstances, the principal modes and other calculations based on Myrkelsted's Method will become difficult. This means that the application of the method will be greatly restricted. This paper shows that for shaft transmission systems of special structure it is possible to establish a point matrix for each of these specific points to eliminate the discontinuity. Discussed in detail is how to build these matrices, and it is shown that Myklested's Method can be applied equally well in such special cases. (Paper received 5 September 1985.)

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CSO: 4009/1023

APPLIED SCIENCES

APPLICATION OF HOLOGRAPHIC FRINGE READER METHOD TO QUANTITATIVE ANALYSIS OF SOLID BIOMECHANICS AND VIBRATION

Shanghai TONGJI DAXUE XUEBAO [JOURNAL OF TONGJI UNIVERSITY] in Chinese Vol 14 No 3, Sep 86 pp 335-348

[English abstract of article by Ding Zuquan [0002 4371 3123], et al., of the Department of Engineering Mechanics]

[Text] Combined with double exposure holography, the holographic fringe reader (HFR) method has quantitatively determined the three-dimensional displacements of the frontal bone and temporal bone of the human skull loaded by concentrated force. Combined with the sandwich holographic interferometry and others, the HFR method has been applied in analyzing the changes of dentomaxilla by Rapid Maxillary Expansion (RME) for the study of the parameters and tissue reaction of the treatment force. Combined with stroboscopic holography, the HFR method is applied to the quantitative analysis of the three-dimensional vibration displacement fields of the violin bridge. These results of three-dimensional displacements were obtained by a micro-computer. (Paper received 8 October 1985.)

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APPLIED SCIENCES

ACOUSTICAL PROPERTIES AND PRACTICAL APPLICATION OF HONEYCOMB COMBINED ABSORBERS

Shanghai TONGJI DAXUE XUEBAO [JOURNAL OF TONGJI UNIVERSITY] in Chinese Vol 14 No 3, Sep 86 pp 365-374

[English abstract of article by Zhong Xiangzhang [6988 4382 3864] of the Institute of Acoustics]

[Text] The widely used high sound absorbing material at present usually consists of fiberglass, minerals, rockwool, etc. These absorbers are complex structures and are difficult to construct. This paper presents a combined absorber in which expanded perlite is filled in a honeycomb. It has the advantages of high sound absorbing coefficient, high rigidity, fire-resistance, the ability to withstand impact and is convenient to construct. The influence factors of the absorbing property are studied in this paper. These new absorbers have been applied to some practical work, the good results have been obtained. (Paper received 9 July 1985.)

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CSO: 4009/1023

APPLIED SCIENCES

NORMAL VIBRATIONS AND RAMAN SCATTERING IN ZnO CRYSTAL

Shanghai TONGJI DAXUE XUEBAO [JOURNAL OF TONGJI UNIVERSITY] in Chinese Vol 14 No 3, Sep 86 pp 381-386

[English abstract of article by Wang Weiguo [3769 5898 0948], et al., of the Department of Physics]

[Text] In both theoretical research and practical applications, ZnO is an important piezoelectric semiconductor and it can be used to replace quartz. We have calculated the normal modes of vibration to ZnO by means of the projection operator O. In addition, we have observed the Raman spectra and obtained six fundamental optical mode frequencies of ZnO. The experimental results are identical with the theoretical predictions. (Paper received 21 October 1985.)

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LIFE SCIENCES

CLONING OF YEAST GENE (Pro2) CODING FOR PROLINE SYNTHESIZING ENZYME (GLUTAMATE PHOSPHATE REDUCTASE) AND Leu⁺ Pro⁺ PHENOTYPIC COTRANSODUCTION

Beijing YICHI AN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 13 No 3, Jun 86
pp 163-171

[English abstract of article by Xuan Jianwu [1357 1696 2976], et al., of Shanghai Institute of Cell Biology, Chinese Academy of Sciences, Shanghai]

[Text] Six gene libraries of Saccharomyces cerevisiae 7209-1A(a) were constructed efficiently with cosmid pHCT9 DNA ligated at their BamHI, PstI and HindIII sites, using HB101 and SC294 as the recipient strains.

Several factors affected the construction of the libraries. With the proper extent of the restriction enzyme digestion of yeast DNA, the F/V ratio for ligation at 15/1, DNA concentration for ligation at 200-250 µg/ml and BHB2688/BHB2690 for in vitro packaging at 5/1, the authors achieved rather high efficiency of library construction (10^6 CFU/µg vector DNA) and low Ap^r Tc^r percentage (down to less than 10 percent or even 5 percent).

The authors found the complementation (suppression) effect on the auxotrophs of leuB, proA (in HB101), leu6, metBl, hisl and argG6 (in SC294, a gift from Dr. G. Hobom). The frequencies of complementation of these six genes are between 10^{-3} and 10^{-4} , while the spontaneous reversion rates in leu, pro, his, met and arg mutants are lower than 10^{-6} . As a result, the authors conclude that the genes (Leu, Pro, Met, His and Arg) on the inserted fragment of yeast DNA in the hybrid plasmid can be functionally expressed in E. coli.

The authors also found a high frequency (>30 percent) of cotransduction of Pro⁺ with the Leu⁺ phenotype in the yeast gene library in HB101. The authors have concentrated the yeast Leu2 gene or suppressor for more than 10^4 times after repackaging and retesting for complementation with pYeuleu5 and pYeuleu7 DNA. (Paper received 8 April 1985; finalized 21 November 1985.)

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CSO: 4009/3007

LIFE SCIENCES

HIGH-RESOLUTION STUDY OF CHROMOSOMES IN HUMAN LUNG ADENOCARCINOMA CELL LINE (LTP-1)

Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 13 No 3, Jun 86 pp 227-231

[English abstract of article by Fan Yaoshan [5400 5069 1472], et al., of the Laboratory of Medical Genetics, Harbin Medical University; Wang Hui [3076 5610], et al., of Beijing Pulmonary Cancer Institute]

[Text] The cells of a human lung adenocarcinoma cell line, LTP-1, were treated with a low concentration of colchicine at the 20th passage, and G-banded early metaphases were analyzed. The modal chromosome number was 100-110, including 32-52 normal chromosomes and 47-73 abnormal chromosomes. Seventeen marker chromosomes were found and six markers involved breaks and rearrangements of chromosome 1 at 1p22, 1q11 and centromeric regions. It was noted that the deletions of 1p31p36 were present in all three human lung adenocarcinoma cell lines studied. These cytogenetic changes may play an important role in the carcinogenesis of human lung adenocarcinoma. (Paper received 31 July 1985.)

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9717
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STUDIES OF NEW ANTHRACYCLINE ANTIBIOTICS 80334 B, C AND F. II. FERMENTATION, ISOLATION, PHYSICOCHEMICAL PROPERTIES, BIOLOGICAL CHARACTERISTICS AND STRUCTURAL DETERMINATION

Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 21 No 6, 29 Jun 86 pp 422-433

[English abstract of article by Zhu Baoquan [2612 1405 3123], et al., of Shanghai Institute of Pharmaceutical Industry, Shanghai]

[Text] Three new antibiotics, antibiotic 80334 B, C and F, have been produced by a culture of strain No 80334, which was identified as Actinosporangium xiangfanensis nov. sp. The fermentation, isolation, purification, physicochemical properties, biological characteristics and structural determination of these new antibiotics are reported. (Paper received 8 July 1985.)

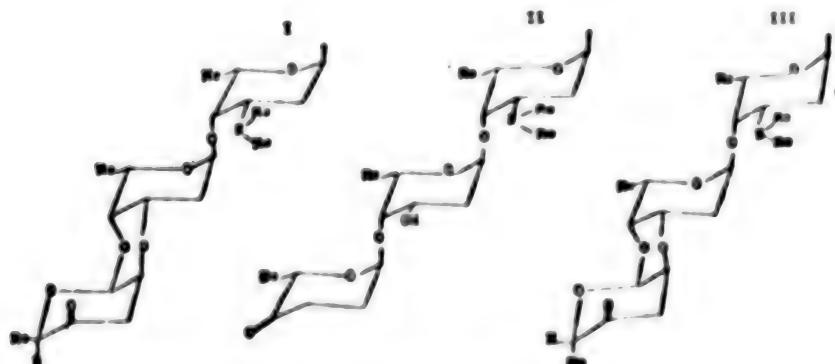
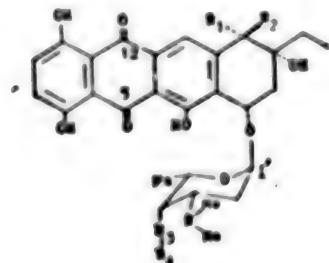


Fig 1. Structures of new antibiotics SIP1 80334 B, C and F

Structures of antibiotic 80334 glycosides



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CSO: 4009/3002

LIFE SCIENCES

SYNTHESIS OF SOME 3(4)-BROMO AND 3,4-DIALKOXY-5-NITROFURAN AZOMETHINE DERIVATIVES AND THEIR ANTIBACTERIAL ACTIVITIES

Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 21 No 6, 29 Jun 86 pp 434-440

[English abstract of article by Lu Jianming [7120 6015 2494], et al., of Shanghai Institute of Pharmaceutical Industry, Shanghai]

[Text] Thirty-two new compounds of 3(4)-bromo-5-nitrofuran azomethine derivatives have been synthesized and their antimicrobial activities investigated.

3(4)-Bromo-2-furaldehyde was prepared from 2-furoic acid or furfural respectively by the previously known method, followed by nitration and condensation to afford the compounds I₂~I₈, II₂~II₈.

Condensation of diethyl diglycolate with diethyl oxalate in the presence of sodium methoxide afforded dimethyl 3,4-dihydroxy-2,5-furandicarboxylate, from which 3,4-dialkoxy-2-furaldehydes were prepared with subsequent O-alkylation, hydrolysis, decarboxylation and Vilsmeier reaction. The nitration of the above aldehydes led to the corresponding 5-nitrated aldehyde diacetates which were converted to the title compounds III₂~III₈, IV₂~IV₈.

Compounds I₂~I₈, I₆~I₇, II₂~II₈ and III₁~III₈ showed bacterial activities in preliminary pharmacological tests and the 4-bromo compounds were more active than the corresponding 3-bromo-isomers and their parent compounds. Most of the 3-brominated, 3,4-dimethoxylated compounds showed less activity than did their respective parent drugs. None of the 3,4-diethoxylated compounds possessed antibacterial activities.

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LIFE SCIENCES

STRUCTURE-ANTICONVULSANT ACTIVITY RELATIONSHIPS OF SOME CINNAMAMIDES OF SUBSTITUTED AROMATIC RING

Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 21 No 7, 29 Jul 86 pp 542-545

[English abstract of article by Wang Shuyu [3769 2579 3768], et al., of Beijing Medical University]

[Text] Twenty-six compounds of halogen, nitro, alkoxy, amino and acetamino substituted cinnamamides have been synthesized. The coupling constants of the NMR spectra of the protons on the double bond of these compounds demonstrate that their configurations are all trans. The anticonvulsant activity (MES) of 3-chloro and 2,4-dichloro substituted cinnamamides were found to be more potent than other members of the series studied. The anticonvulsant activities of electron donating amino substituted cinnamoyl piperidines are comparable to those of the chloro compounds.

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CSO: 4009/3009

LIFE SCIENCES

INTERACTIONS BETWEEN DIHYDROETORPHINE, L-TETRAHYDROPALMATINE, B-7601 AND DIAZEPAM

Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 21 No 8, 29 Aug 86 pp 561-565

[English abstract of article by Bian Chunfu [0593 2504 3940], et al., of the Department of Pharmacology, Xuzhou Medical College]

[Text] In rabbits, l-tetrahydropalmatine (l-THP), 10, 20 or 30 mg/kg, given intravenously, induced loss of the righting reflex. The dose-effect relationship appeared to be linear, which shifted to the left when dihydroetorphine (DHE) 1 µg/kg was given intravenously in combination with l-THP. The EEG changed gradually from low voltage rapid wave to high voltage slow wave. In mice, l-THP (10 mg/kg, ip) and DHE (2 µg/kg, ip) elevated the pain threshold (hot plate method measured at the 10th min) by 135 ± 35 percent ($\bar{X} \pm SD$) and 40 ± 10 percent ($P < 0.01$) respectively. However, when the two drugs were given in combination, the pain threshold increased by 339 ± 20 percent. These results suggest that their actions on CNS are synergistic.

The decrease in heart rate in rabbits following DHE can be antagonized by B-7601. DHE was shown to inhibit respiration, and this action was antagonized to some extent by l-THP.

The combined use of DHE (1 µg/kg), B-7601 (0.5 mg/kg), a new muscarinic antagonist, L-THP (20 mg/kg) and diazepam (2 mg/kg) by the intravenous route induced immediate general anesthesia and disappearance of electromyogram in dogs. The duration of the loss of the righting reflex was 172 ± 44 min. Thus, an adequate anesthetic state for an abdominal operation was attained. (Paper received 15 July 1985.)

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LIFE SCIENCES

QUANTITATIVE STRUCTURE-ANTICONVULSANT ACTIVITY RELATIONSHIPS OF CINNAMAMIDES

Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 21 No 8, 29 Aug 86 pp 580-585

[English abstract of article by Li Renli [2621 0088 0448], et al., of the School of Pharmaceutical Sciences, Beijing Medical University]

[Text] The anticonvulsant activities of 38 cinnamamides have been used to formulate quantitative structure-activity relationships. The correlations indicate that the activity of this series of compounds is parabolically related to the partition coefficients ($\log P$ octanol/water) of the compounds. Hammett σ constants and steric parameters (MR) of the substituents can significantly improve the correlations. The equation indicates that the substituents with electron withdrawing effects and small steric parameters will increase the anticonvulsant activity of cinnamamide. The correlation analysis of 20 N-cinnamoyl piperidines out of the 38 cinnamamides produces a similar equation. (Paper received 27 August 1985.)

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LIFE SCIENCES

STUDIES OF PURITY OF CHINESE MEGESTROL ACETATE: SEPARATION AND IDENTIFICATION OF EPIMERIC ISOMERS OF 6-HYDROXY-6-METHYL-17 α -ACETOXY-PROGESTERONE

Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 21 No 8, 29 Aug 86 pp 613-617

[English abstract of article by Fang Xueguang [2455 7185 0342], et al., of the National Institute for the Control of Pharmaceutical and Biological Products, Beijing]

[Text] Two impurities are separated from Chinese megestrol acetate by column chromatography and thin-layer chromatography. On the basis of UV, IR, ^1H NMR, ^{13}C NMR spectroscopy and EI mass spectrometry, these two impurities were identified as 6 α -hydroxy-6 β -methyl-17 α -acetoxy-progesterone and its epimeric isomer 6 β -hydroxy-6 α -methyl-17 α -acetoxy-progesterone. Reported here are the optimal TLC conditions (silica GF₂₅₄, ethyl acetate-toluene = 7:3) and the spectral data. (Paper received 28 October 1985.)

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PROPHYLACTICALLY ANTIMETASTATIC EFFECTS OF ARYLTRIAZENE METHOXYPYRIMIDINE
ON LEWIS LUNG CARCINOMA AND ITS HISTOLOGICAL AND ULTRASTRUCTURAL OBSERVATION

Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 21 No 8,
29 Aug 86 pp 623-626

[English abstract of article by Jiang Chun [3068 2504], et al., of Tianjin
Medical and Pharmaceutical Science Institute]

[Text] The antimetastatic effects of aryltriazene methoxypyrimidine (ATMP) were investigated in mice implanted intramuscularly with Lewis lung carcinoma in the calf of the hind leg. The primary tumor was removed surgically by amputation in mice treated with the tested compounds pre-operatively and postoperatively. The results show that amputation alone on the 9th or 11th day after tumor implantation did not prevent pulmonary metastasis. Prophylactically antimetastatic effects on spontaneous metastasis were observed with the treatment of ATMP when neoplasm spreading had not taken place. It was indicated, with histological examination, that after ATMP administration, the cancer cells of the primary tumor entering the blood and lymphatic vessels had been prevented. Observation with an electron microscope showed some ultrastructural changes including the strengthening of the gap junction, more abundance of collagen fibrils and lack of microfilament in tumor tissue of the ATMP treated group.

The selectively antimetastatic effect of ATMP on LA-795 lung adenocarcinoma was also demonstrated. (Paper received 14 October 1985.)

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